CIVIL ENGINEERING

BROADWAY TUNNEL

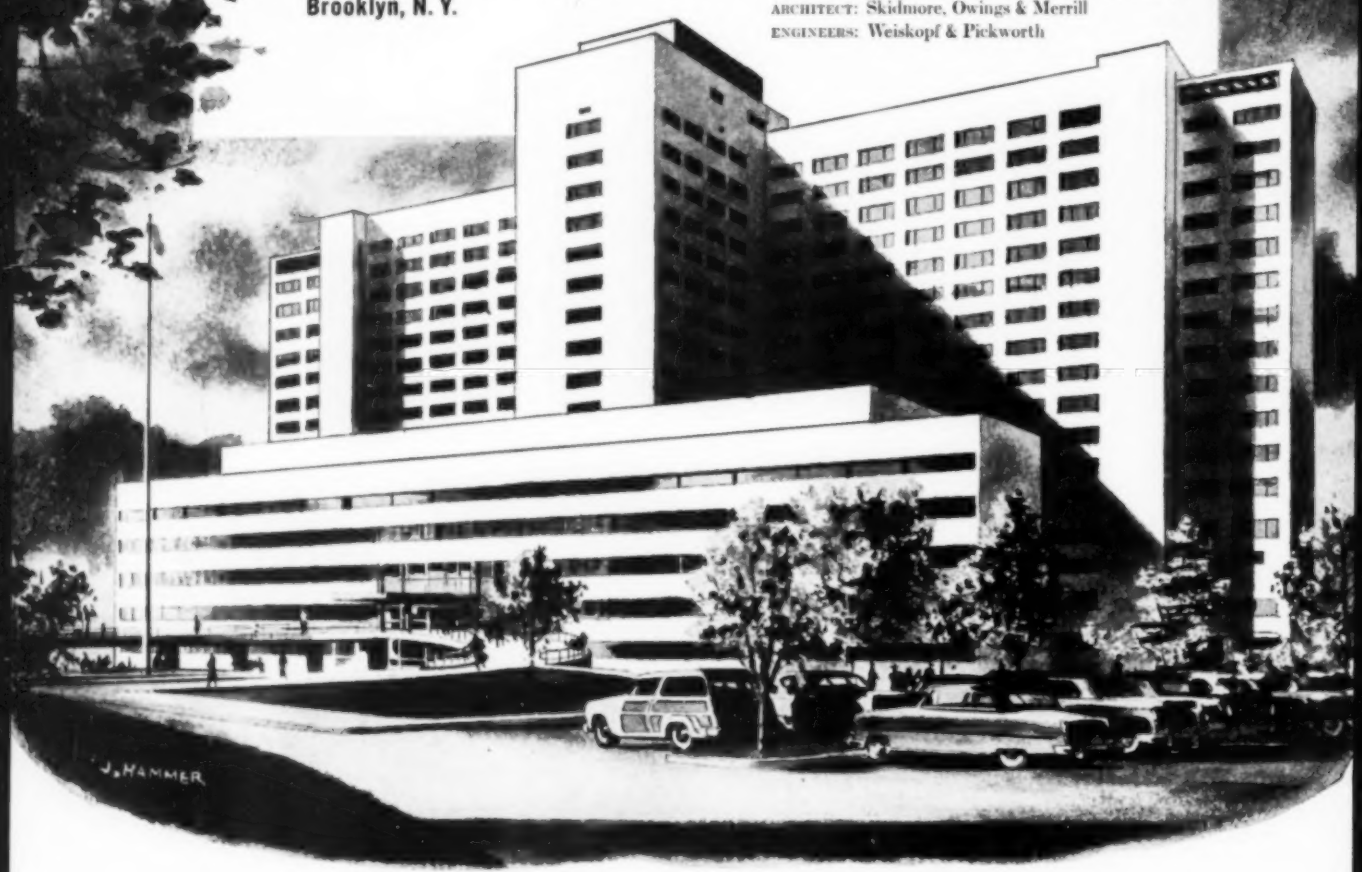
SAN FRANCISCO

See article by R. G. Wadsworth

...the finest structures rest on RAYMOND FOUNDATIONS

FORT HAMILTON VETERANS HOSPITAL
Brooklyn, N. Y.

GENERAL CONTRACTOR: Cauldwell-Wingate Co.
FOUNDATION CONTRACTOR: Stock Construction Corp.
ARCHITECT: Skidmore, Owings & Merrill
ENGINEERS: Weiskopf & Pickworth

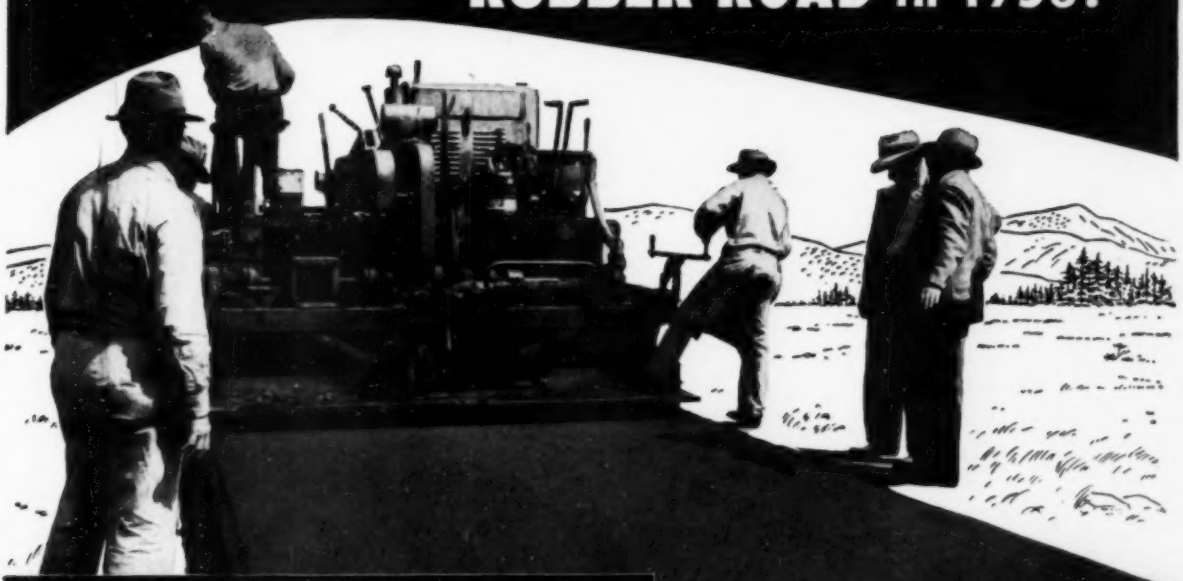


THE SCOPE OF RAYMOND'S ACTIVITIES—Soil Investigations... Foundation Construction ... Harbor and Waterfront Improvements...Prestressed Concrete Construction ... Cement-mortar In-place Lining of Water, Oil and Gas Pipelines.

RAYMOND
CONCRETE PILE CO.
140 Cedar Street • New York 6, N. Y.

Branch Offices in the Principal Cities of United States and Central and South America

NOW is the time to plan for your test RUBBER ROAD in 1953!



MAIL THIS INQUIRY SHEET *today*

NATURAL RUBBER BUREAU
1631 K Street, N. W., Washington 6, D. C.

With no obligation, please send me engineering data for laying a test strip of natural rubber-asphalt pavement as follows:

1. Length of proposed test strip ..... miles
   Width of proposed test strip ..... feet
2. New Construction ☐ Resurfacing ☐

PLANT MIX	SURFACE TREATMENT
Type: Hot ☐ Cold ☐	Grade of Bitumen .....
Grade of Asphalt	Application Rate ....gals. per sq. yd.
Penetration	
Depth of Top Course ..... inches	COVER MATERIAL
Aggregate Content .....%	Type of Aggregate .....
Aggregate Top Size .....%	Size of Aggregate .....
Bitumen Content .....%	Lbs. per sq. yd. .....

Name .....
Title .....
Dept. .....
Address .....
City ..... State .....

☐ Please send booklet "STRETCHING HIGHWAY DOLLARS WITH RUBBER ROADS"

☐ Please send information about new 30-minute motion picture on rubber roads

Many Engineers Planning Rubber Roads This Year

The biggest road-building season in America's history will soon be in full swing. High on the priority list of jobs in many states and cities will be a test strip of natural rubber-asphalt road.

Results from more than a score of test roads of natural rubber laid in the U. S. since 1949 give definite promise of a new era in highway building. Both laboratory and in-place studies indicate that natural rubber roads will last longer, require less maintenance and aid greatly in stretching overburdened highway budgets.

If you have not already investigated this newest highway development we urge you to plan now for a test rubber road installation during the 1953 paving season.

The Natural Rubber Bureau's Research Laboratory is staffed with experienced highway engineers who are ready to assist you with technical data on installing natural rubber roads.

Simply fill out the coupon and mail it to the

Natural Rubber Bureau

1631 K STREET, N. W. WASHINGTON 6, D. C.

Natural Rubber Bureau Research Laboratory
Rosslyn, Virginia

CIVIL ENGINEERING, The Magazine of Engineered Construction, April, 1953. Vol. 23, No. 4. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930 at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Table of Contents is on page 31.

It's the way a Berger Transit is made that makes it better

AN OPTICAL CONCLUSION

You're looking at the "eyes" of a Berger Engineers' Transit —the optical reasons why the image you see through a Berger is so clear and sharp—why the telescope line of collimation is permanently unvarying and true.

Here, six precisely ground and polished lenses of specially selected glass, perfectly aligned in a Berger erecting-interior focusing telescope, combine just the right balance of optical precision to guard against chromatic or spherical aberration.

The optical line of sight is true to the mechanical center line of the telescope and at right angles to the axis bearings. The smoothly ground focusing slide is hand fitted to the telescope barrel—which has been accurately bored and lapped from end to end—to a smooth sliding fit with no shake; *yet no lubrication is required.*

You will welcome this preciseness of machining and assembly, in the free, smooth focusing action of a Berger with its easy-meshing rack and pinion—no binding or side play —no back lash.

An optically true line of sight is just one more of the many *extra* long term values you are sure of when you buy BERGER . . . as so many leading engineers do.

C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Mass.
342 Madison Ave., New York 17

IF YOU'VE NEVER OWNED A BERGER, *you owe it to yourself to learn how accurate it really is . . . how little repair it requires . . . the lifetime of trouble-free service you can count on . . . how inexpensive a Berger Instrument is in the long run. Write for a copy of "Accuracy in Action."*

THE BEST IN ~~SIGHT~~ IS **BERGER**

ENGINEERING AND SURVEYING INSTRUMENTS . . . SINCE 1871

HIGH UP

. . . on the list of "Economy Short-cuts" for the $4 Million Nassau County Sewer Expansion was . . .

FOSTER RENTAL PILING

Hendrickson Bros. Inc.

GENERAL CONTRACTORS
EXCAVATING · GRADING · HEAVY CONSTRUCTION

63 NORTH CENTRAL AVENUE
VALLEY STREAM, N. Y.

L. B. Foster Co.
11 Park Place
New York 7, N. Y.

Re: N. C. Sewage Disposal Plant

Gentlemen:

Because this job was near the ocean, we had to get Interlocking Steel Sheet Piling to hold back mud at subgrades, to assure dry working conditions. Contract requirements made time of utmost importance, so we turned to Foster for prompt delivery of just what we needed. Needless to add, your prompt delivery was taken for granted -- and furthermore we figure that we effected a considerable saving because of your low rental rates.

Yours very truly,

HENDRICKSON BROS., INC.

Arthur J. Hendrickson

Arthur J. Hendrickson,
President.

1,000 feet of Foster Rental Piling serviced 10,000 feet of this job for Hendrickson Bros. They rented 1,000 ft. to be driven in the relatively soft subsurface a total of ten times—piling being in place a week before pulled for re-use in advanced location. The complex piling requirements were best serviced from Foster's large rental stocks with the exact lengths and the exact sections the job required, at economical low rental rates.

Let us quote you on our low-cost piling rentals—prompt service from five Foster warehouses. Send for New Piling Catalog illustrating diagrams of all standard-make sections, ask for Catalog CV-4.

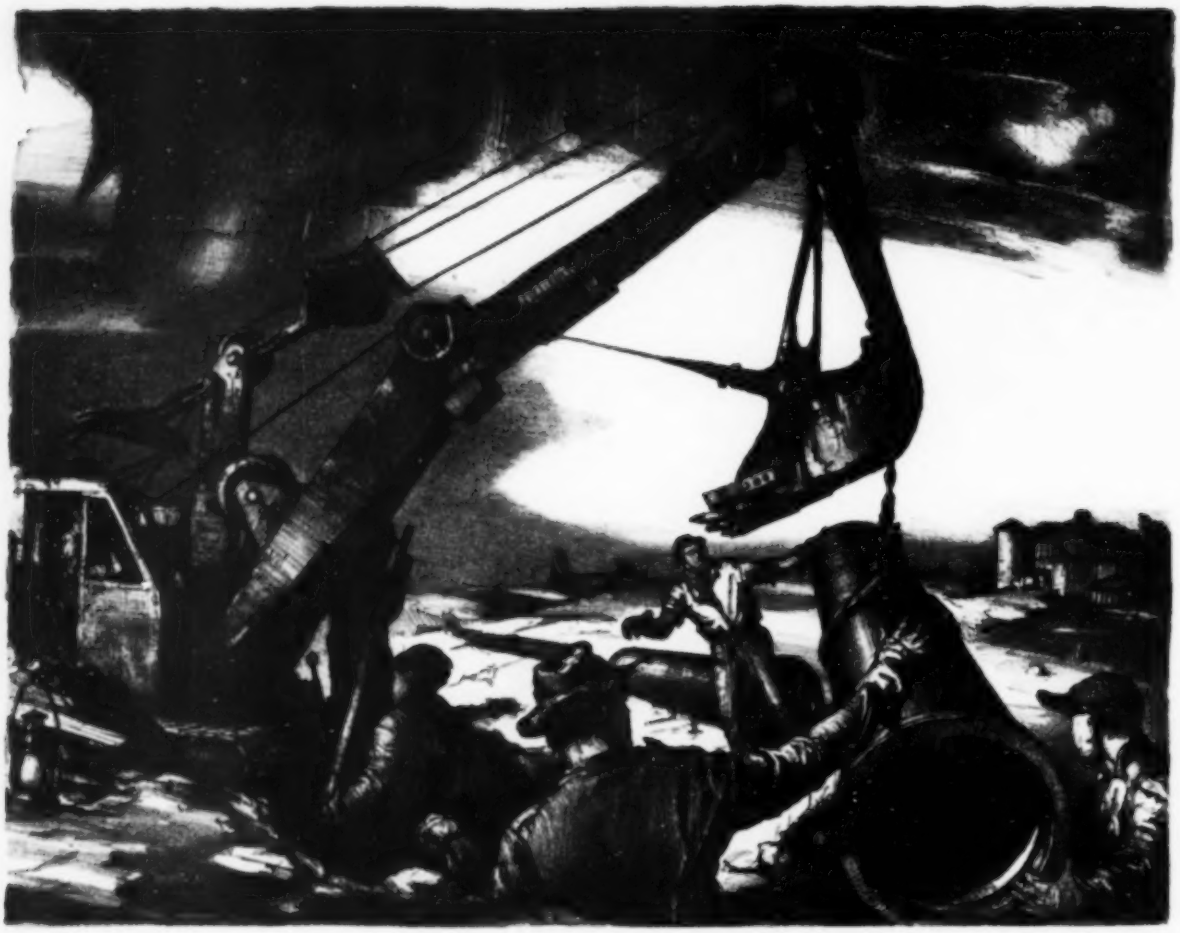
66-inch diameter precast conduit at an average depth of 35 ft.—placed atop a 7-inch concrete slab.

Piling holds back mud for The Sanitary Trunk Sewer conduit which ran 7 miles on Long Island's South Shore.

RAILS—TRACK EQUIPMENT • PIPE • WIRE ROPE

L. B. FOSTER CO.

PITTSBURGH 30, PA. • NEW YORK 7, N.Y. • CHICAGO 4, ILL. • HOUSTON 2, TEX.



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A.N.A.

THIS RURAL SCENE is not an unusual background for cast iron pipe. The installation might be a water supply line for a city nearby. It could be a sewer force main leading to a treatment plant. Also it might be a gas transmission line for a city, in which case it would unquestionably be of the mechanical joint type.

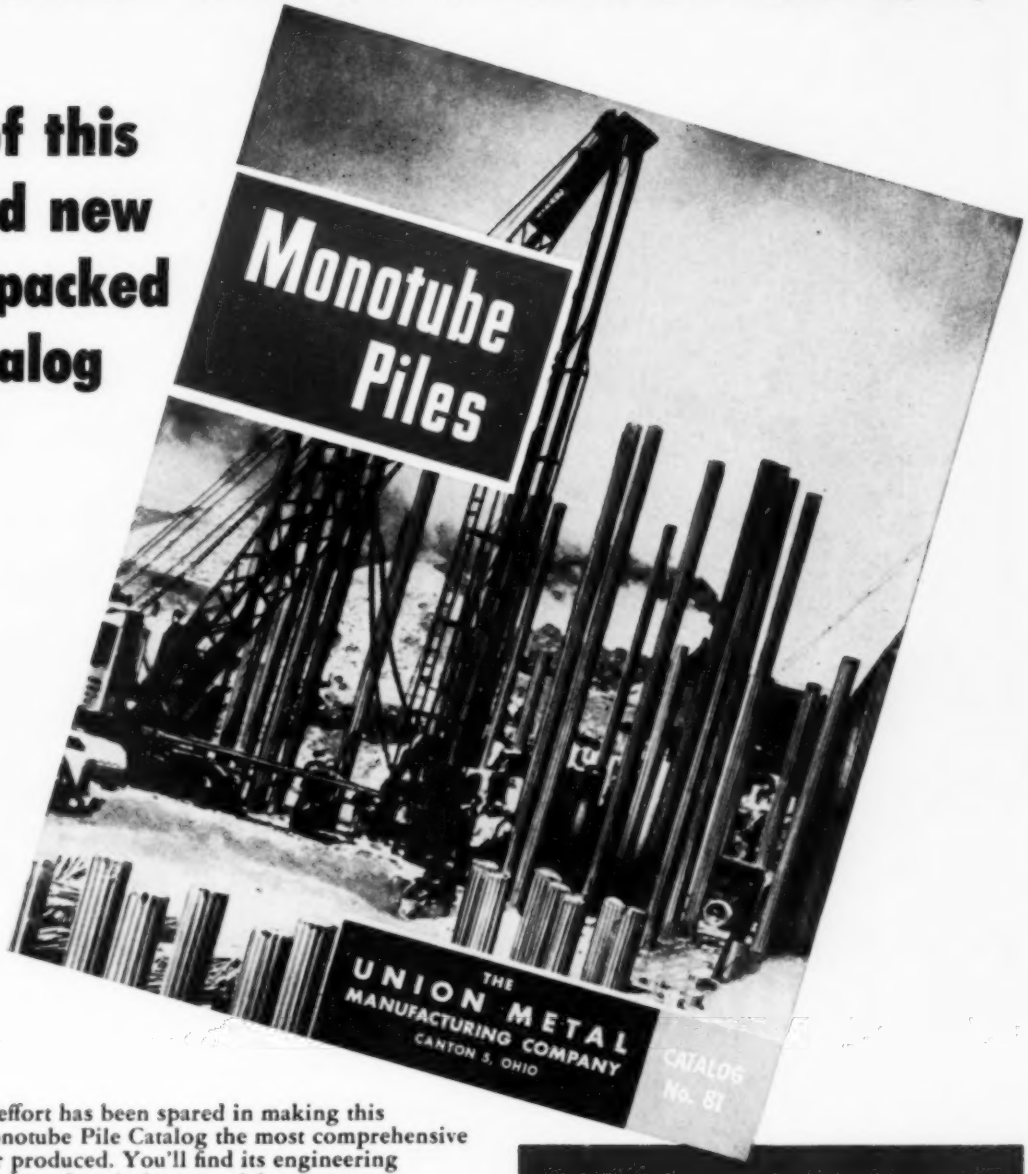
U. S. cast iron pipe in sizes 2-inch through 24-inch are cast centrifugally in metal molds with bell-and-spigot; mechanical joints and plain ends. All sizes of flexible joint and integral flange pipe and all pipe 30-inch and larger are cast by the pit cast process. By whichever process the pipe is made, high quality is assured with the modern control methods employed during its manufacture.

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

U.S.
cast iron
PIPE
FOR WATER AND GAS DISTRIBUTION
AND INDUSTRIAL SERVICE

SEND FOR YOUR COPY

...of this brand new data-packed catalog



NO effort has been spared in making this new Monotube Pile Catalog the most comprehensive one ever produced. You'll find its engineering and test data, descriptive material, numerous application photos, etc., to be interesting, helpful and valuable as a reference source. For your copy, use the handy coupon or write to The Union Metal Manufacturing Co., Canton 5, Ohio.

UNION METAL
Monotube Foundation Piles

FOR YOUR CONVENIENCE

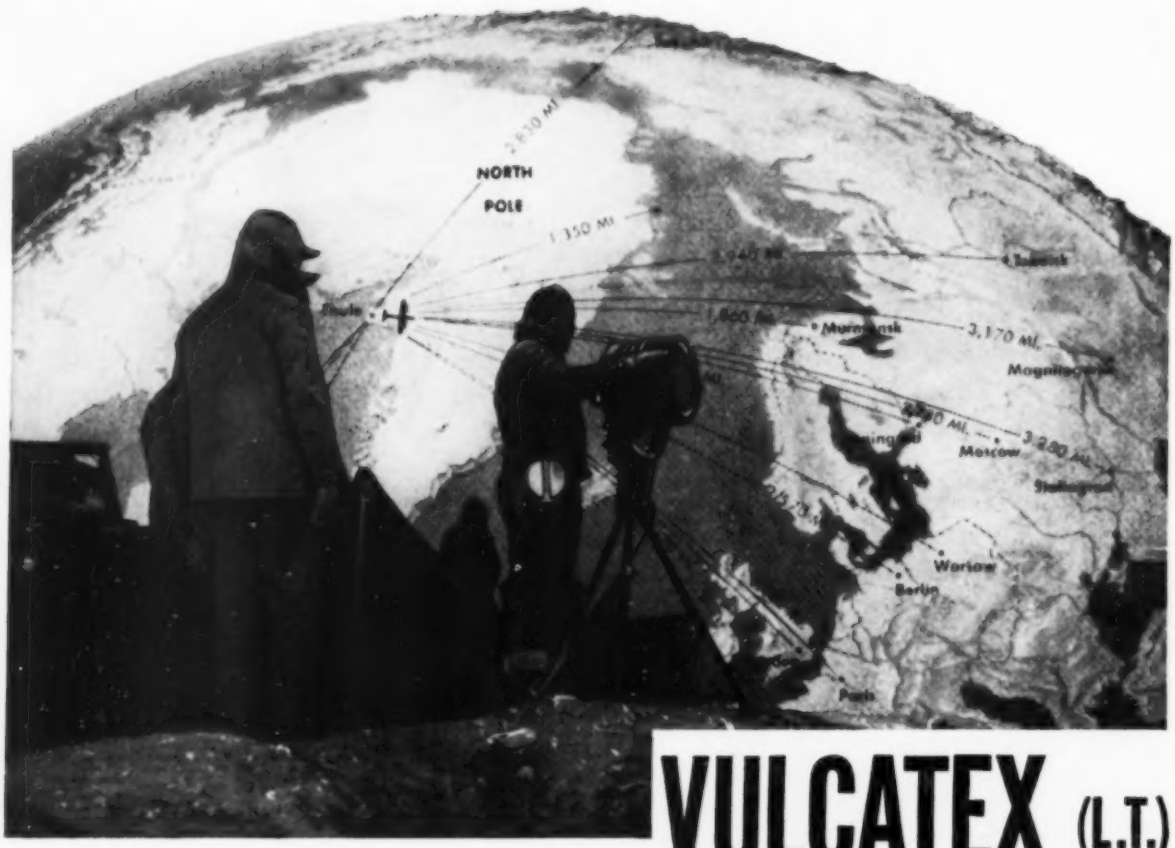
NAME_____

TITLE_____

AFFILIATED WITH_____

ADDRESS_____

CITY_____ STATE_____



VULCATEX (L.T.)

OUT COLD ON OPERATION 60 DEGREES BELOW ZERO

Through the announcement of the Defense department the public now knows about operation "Blue Jay" only 900 miles from the North Pole. This modern engineering miracle is a full scale year round bomber base. Temperatures of minus 60° F are common and winds drive rain or snow against the structures at 150 miles per hour. In such cold even rubber and steel become brittle.

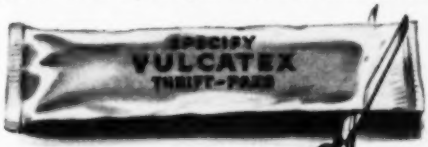
The A. C. Horn Company Inc. has the honor of having supplied over 40,000 gallons of its special low temperature Vulcatex Elastic Caulking Compound. This was used in the joints and between the panels of the many pre-fabricated structures for water-tight, air-tight seals.

Operation "Blue Jay" in spite of the inhuman cold is now described

CAULKING COMPOUND KEEPS "BLUE JAY," GREENLAND, AT

as "Snug" and the workers and service men enjoy better than normal health. Vulcatex (L.T.) Caulking Compound keeps the heat in and the fierce cold out. Thousands of other important buildings in the United States and throughout the world are also protected by Vulcatex in every climate and type of structure.

Vulcatex, a product of the Horn Research Laboratories, has outstanding properties of plasticity, adhesion and long life. Many applications over 20 years old are still completely effective. You can rely on the performance of any Horn product. This has been true for 56 years.



A. C. HORN COMPANY, INC.,
Long Island City 1, N. Y.

CE 53

Please send me ☐ complete data on VULCATEX

HORN

☐ free copy of your 106-page Construction Data Handbook

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FIRM NAME _____

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CITY _____ STATE _____

A. C. HORN CO., Inc. est. 1897

Manufacturers of materials for building maintenance and construction
LONG ISLAND CITY 1, N. Y. • Los Angeles • San Francisco • Houston
Chicago • Toronto SUBSIDIARY OF SUN CHEMICAL CORPORATION

360 MILES TO UNGAVA IRON

and it's a tough job every inch of the way

Two Gardner-Denver compressors, powered by Cat D8800 Engines, furnish air for drilling blast holes.

A D8 with No. 8A 'Dozer pioneers a path for drill crews and compressors. This is typical terrain.

One of the most spectacular engineering jobs of this century is the construction of a railroad from Seven Islands, Quebec, on the St. Lawrence, to Knob Lake, 850 miles from the Arctic Circle. It is being built for the Iron Ore Company of Canada, to tap the rich iron deposits of the Ungava region.

Early last year a section boss, working on the right of way that runs northward to Labrador, made a historic remark. Quoted in a national magazine, he said, "Without the Cat* and the airplane that ore would sure stay up there a mighty long time."

This P & H 1½-yd. shovel, excavating on the right of way, is powered by a Caterpillar D13000 Engine.

It was the airplane that flew in the men and the first small tractors and bulldozers. They in turn built the landing fields for bigger planes to bring in bigger earthmovers. Since then the battle has gone forward, foot by rugged foot, through the wilderness.

Today, at a rough estimate, more than 250 miles of right of way have been cleared and 190 miles rough-graded. Something over 110 miles of track have been laid and are in use.

Handling the job are four big contracting firms which have pooled their resources under the name of C.M.M.K. The initials stand for Cartier Construction Co., McNamara Construction Co., Mannix Ltd. and Morrison-Knudsen of Canada. An immense quantity of equipment has been assembled by the combined companies. It includes track-type tractors and bulldozers, wheel tractors and scrapers, wagons, motor graders, shovels, cranes, compressors, engines and electric sets. About 195 Caterpillar* units are in use — roughly two-thirds of the total machines on the job.

The route traverses extremely rough terrain, with mountains, dense forests and 1,000-foot canyons to be crossed. Much of it has to be blasted out of solid rock, and in the whole 360 miles there isn't a yard that isn't tough.

In the bitter months of midwinter much of the equipment is laid up in the

At this point the grade is nearly ready for rail. A Cat No. 12 Motor Grader is shown spreading and leveling fill.

scores of camps that have been built along the route. During this period operations and maintenance men have an opportunity to overhaul the machines in preparation for open weather. Caterpillar Dealers have sent some of their best service men and special tools to the base camps to help with the work.

The cost of the railroad project has been estimated at $200,000,000, and it may easily run higher. Started in the fall of 1950, it is expected that the job will be completed and the first ore hauled out in 1954. Meanwhile the mines are being developed, and within two or three years this area should be furnishing the raw material for a big share of America's steel.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

*Both Cat and Caterpillar are registered trademarks—®

SAVE STEEL SAVE MONEY

Webb Housing Project, New York City.
Contractor: Starrett Bros. and Eken.
Architect: Leonard Schultze Associates.
Structural Engineer: J. DiStasio and Company.

...build with REINFORCED CONCRETE

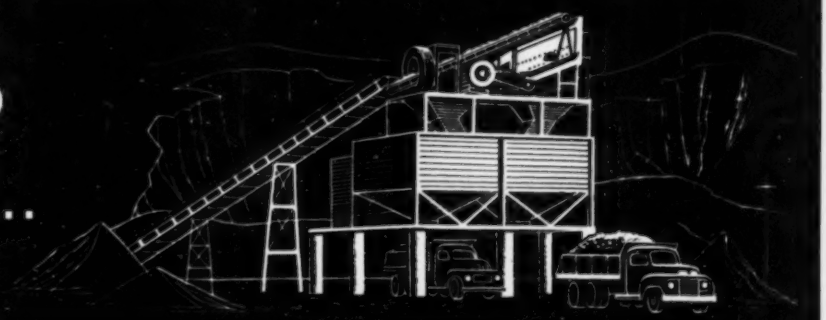
● This housing development got a good start in life—it was designed for *reinforced concrete*!

Builders know they can count on a saving in steel, a saving in costs, a saving in construction time with reinforced concrete. They know they can count, too, on durable strength . . . on structures that are inherently firesafe, highly resistant to wind, shock, and quakes. These are the qualities that *always* go hand-in-hand with reinforced concrete. Use it for *your* next building!

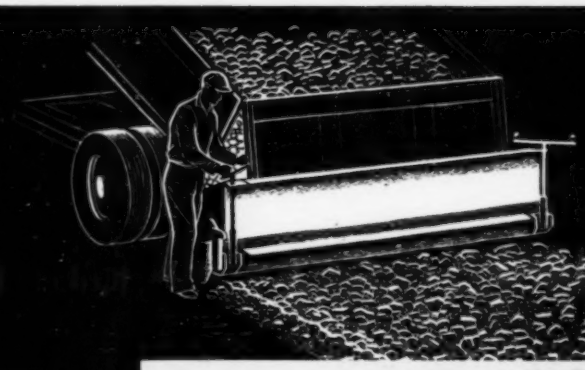
CONCRETE REINFORCING STEEL INSTITUTE • 38 South Dearborn Street, Chicago 3, Illinois

B I T U M U L S I S V E R S A T I L E

Tonnage is UP
at the quarry...



Costs are DOWN
on the job...



Typical Bitumuls Full Penetration Macadam Pavement

when Penetration Macadam roads are built with Graded Aggregates and BITUMULS®

HERE'S HOW ROAD-BUILDERS avoid the expense of placing and compacting base rock, choke stone and key stone *separately* in the construction of Penetration Macadam.

Quarry owners are able to make a blended aggregate that has been *graded at the quarry* to provide the specified percentage of each size of stone that assures close interlocking when compacted. The result is higher production for the quarry; savings in time and labor for the Road-Builder; better roads at lower costs for the city, county or state.

WHY BITUMULS?

Graded aggregate, properly placed and compacted, forms a dense mass with a minimum of voids. *Only* Bitumuls—applied cold—can *completely* penetrate this dense, closely-interlocked mass, coating each stone with a thin film of pure asphalt. This provides a mud-and-water seal for the pavement base and maintains the maximum bearing strength that is inherent in Bitumuls Full Penetration Macadam.

Full Penetration Macadam is suitable for either new construction or for resurfacing existing pavements.

There are Bitumuls Engineers working out of plants near you. They welcome an opportunity to furnish details on this method of pavement construction, or to discuss other paving problems. From these same plants, Bitumuls in both Quick-Setting and Mixing Grades is available for prompt, on-job delivery.

AMERICAN Bitumuls & Asphalt COMPANY

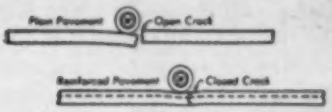
200 BUSH STREET • SAN FRANCISCO 4, CALIFORNIA

E. Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Mobile, Ala. Columbus 15, Ohio Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La. St. Louis 17, Mo. Inglewood, Calif. Oakland 1, Calif. Portland 7, Ore. Washington 6, D. C. San Juan 23, P. R.

The Edens Expressway

Shown here is a typical section of the Edens Expressway, an important part of the highway network that serves the Chicago area. Cook County highway engineers, working with Illinois State highway engineers, specified American Welded Wire Fabric reinforcement with contraction joint spaces of 100'-0" centers to insure long, trouble-free service and a smooth riding surface from this main traffic artery—and also reduced construction costs.

IDEAL FOR USE with modern paving machinery, American Welded Wire Fabric is also generally preferred for concrete reinforcement in city streets, curbs, sidewalks and sewers—in culverts, abutments and bridges—in foundations, yards, floors, walls and roofs of all sorts of buildings.



AS THE WHEEL LOAD approaches an open crack in plain pavement, one slab end carries the entire load. As the wheel approaches the closed crack in pavement reinforced with American Welded Wire Fabric, both slab ends, instead of one, carry the load, preventing damage to the slab and to the subgrade, reducing the rate of cracking, preventing heaving and spalling, which reduces maintenance cost and increases the service life of the highway.

built stronger, to last longer and to ride smoother with AMERICAN WELDED WIRE FABRIC

On many a mile of the Nation's highway system, American Welded Wire Fabric has helped to improve driving conditions, reduce construction costs and save important money on maintenance—and very important, it protects the public's investment through longer pavement life.

With American Welded Wire Fabric, the many small high-yield steel members keep the driving surface smooth and even, make possible longer slabs and fewer joints, hence increase riding comfort and safety.

The big flat sheets are easily placed by minimum crews, lie flat and stay put during pouring. Higher allowable stresses mean that you use less steel, less concrete. The result is—savings on materials and labor that sharply reduce construction costs.

Long experience has proved that American Welded Wire Fabric reinforcement reduces the rate of cracking, prevents progressive damage to slab and subgrade, insures additional years of trouble-free service, thus cutting maintenance costs to the bone.

Our specialists will be glad to consult with you on your individual reinforcing problems. You will find that most jobs can be handled with some of the many standard designs, styles and sizes of American Welded Wire Fabric that are now readily available. Why not drop a line to our nearest sales office for a copy of the American Welded Wire Fabric Catalog.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
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UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

EVERY TYPE OF REINFORCED CONCRETE CONSTRUCTION NEEDS

U·S·S AMERICAN WELDED WIRE FABRIC

UNITED STATES STEEL

that only C-P-P* meets the BIG 3 REQUIREMENTS

Cleveland's Fire Chief knows how vital *high capacity* can be in a water line. Not long ago he said:

"Of the seven major factors in grading a city (for insurance), the most important is water supply. We get a lot of deficiency points from the underwriters because much of our 1,500 miles of water mains are old *and* tuberculation *has reduced their capacity."*

But Cleveland is solving this problem. Price Prestressed Concrete Pipe is now going in on a number of 16-inch, 24-inch, 30-inch and 36-inch supply lines.

Future fire chiefs won't have to worry about tuberculation or corrosion in these lines. Price Pipe *maintains* a high carrying capacity over the years because concrete has the highest flow coefficient of any pressure pipe structural material, and because the flow of water over concrete creates a slippery surface that actually *aids* the flow of water, rather than retarding it.

Price Pipe has long life too. Concrete buried under ground is as ageless as limestone. *Long life* with *continued high carrying capacity* is a tough combination to beat.

But Price Pipe has one other big plus value . . . *great strength.* It is safer from external loads, and sudden complete failure is all but impossible.

Add to these "Big 3" the other advantages of easy installation, easy tapping, watertightness, low original cost and low maintenance . . . and you can see why Cleveland specs now call for concrete bids on all lines 16 inch and over.

For all the facts on Price Pipe, write today.

only CONCRETE PRESSURE PIPE MEETS THE BIG 3 REQUIREMENTS

Price Brothers Company

1837 East Monument Avenue, Dayton 1, Ohio

Please send me, without obligation, the following literature:

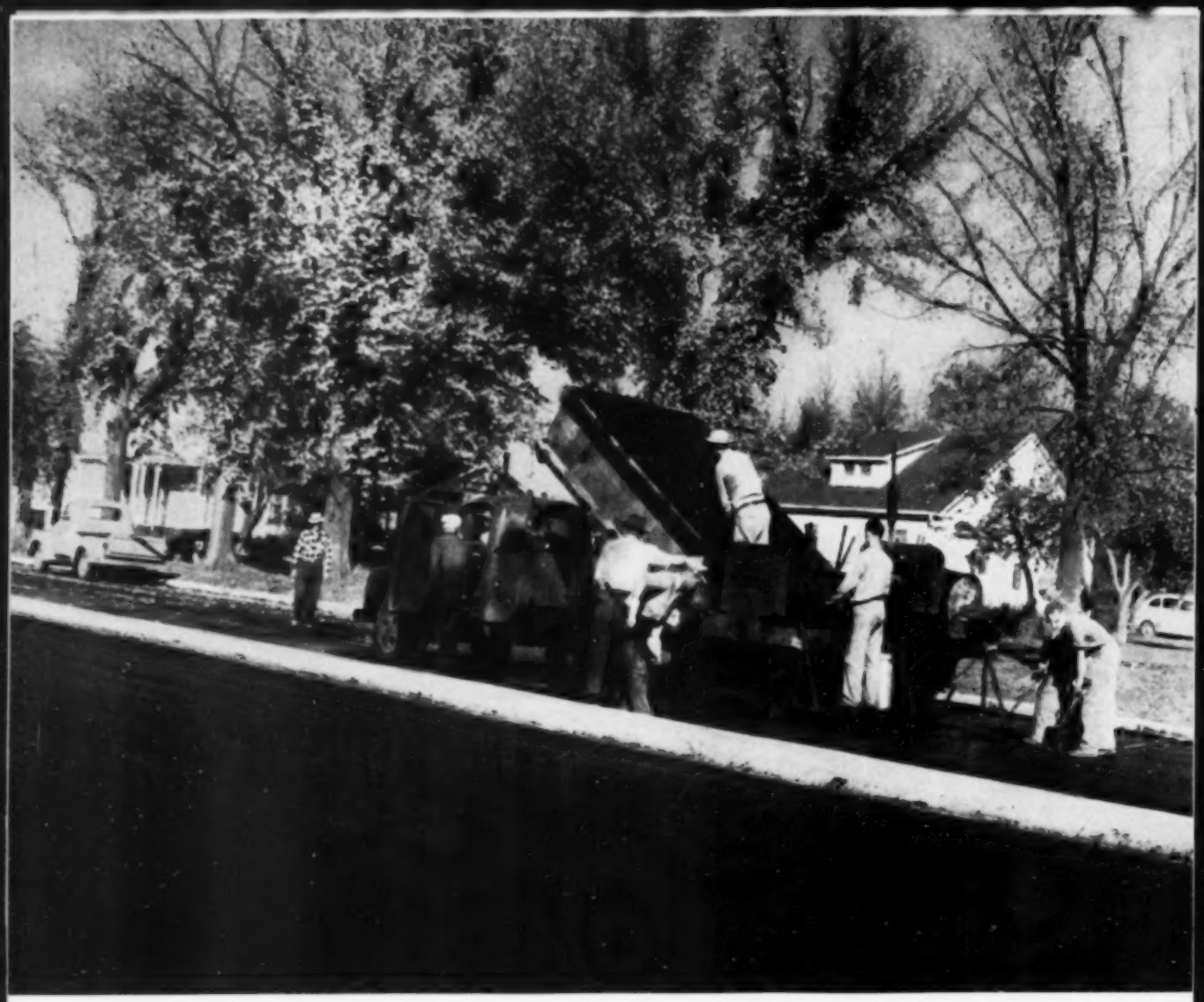
- ☐ Check Sheet of Water Line Requirements
- ☐ Facts on Prestressed Pipe
- ☐ Price Pipe for Pressure Sewer Lines

Name_____

Title_____

Organization_____

Address_____



Paving the way for savings

● When you use asphalt construction or resurfacing for city street or highway, you're paving the way for real savings in time and money. When you use Standard Oil asphalt you're gaining even greater road-building economy.

You save time because easier laying of asphalt, use of lighter and faster equipment, and the rapid setting of asphalt all help to speed road construction.

You save money because faster paving means fewer man-hours and lower labor costs. Local aggregate can be used to keep material and material handling expenses at a minimum. The durability of asphalt paving brings savings in the long run. Asphalt and heavy aggregate, mixed, make strong road foundations. Top courses of asphalt, stone, and sand present long-wearing, waterproof surfaces. Maintenance, when necessary, takes a minimum of time, labor, and materials.

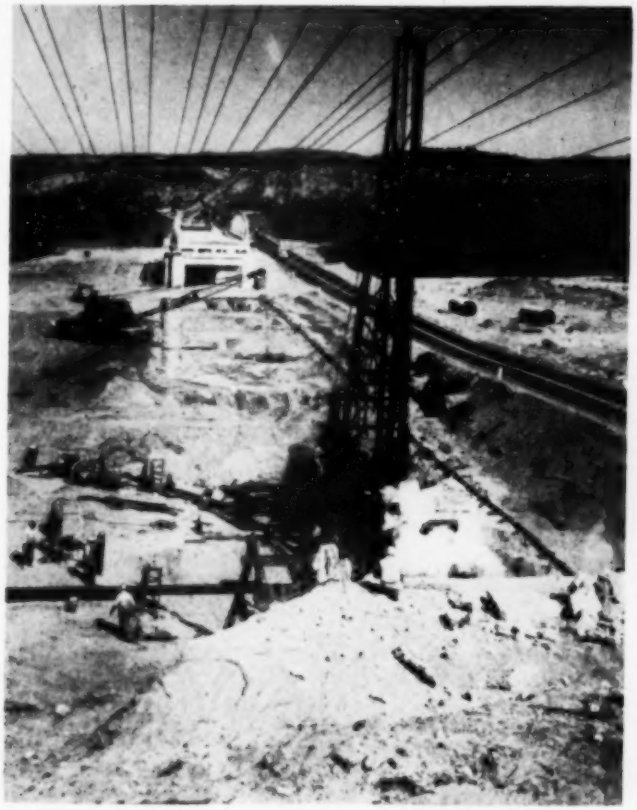
You add further to these savings by using Standard Oil asphalt. With five asphalt-producing refineries located throughout the Midwest, Standard makes the haul to your site a short one. Prompt, reliable shipments eliminate work delays. Freight costs are at a minimum. A Standard Asphalt Representative will be glad to work with you on your job needs. For his services, write: Standard Oil Company (Ind.), 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL
ASPHALT

STANDARD OIL COMPANY

STANDARD *(Indiana)*

100% PERFORMANCE ON ROUTE 1 BY USING *Stang* WELLPOINT SYSTEM



Trestle over the Santa Ynez River north of Lompoc, Calif., on Route 1 Calif. State Highway was washed out during recent floods, the normal heavy traffic being detoured (right of top Picture). Soil conditions encountered were medium to fine sand strata, fully saturated to natural grade. Removal of old piers and construction of a new bridge was required and needless to say "time was the essence of the contract."

The contractor Madonna Construction Co. of San Luis Obispo, Calif., dried the entire working area by surrounding it by a STANG Wellpoint System. Excavation for removal of old piers and for the new work was accomplished in DRY earth without the use of sheeting and bracing, resulting in LOWER COSTS—SHORTER TIME.

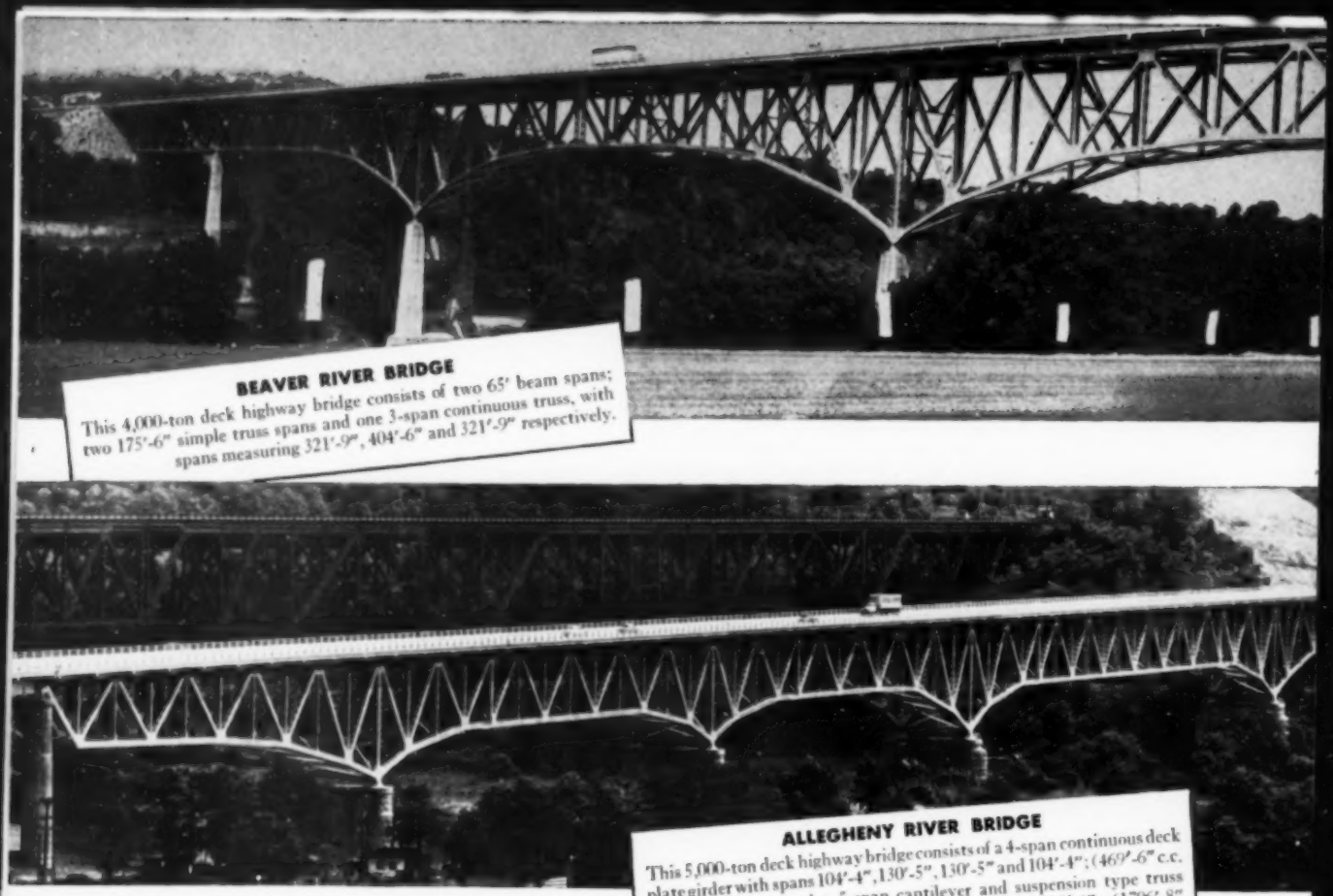
Note sequence of operations after dewatering —Piledriver follows excavating equipment with no time loss.

Removal of wrecked abutment and excavation for the new ▶

JOHN W. STANG CORPORATION

Engineers and Manufacturers of Dewatering Equipment

BELL, CALIFORNIA	OMAHA, NEBRASKA	TACOMA, WASHINGTON	NEW YORK CITY, NEW YORK
8221 Atlantic Avenue	2123 South 56th Street	2339 Lincoln Avenue	Number Two Broadway
P. O. Box 631 Telephone: Logan 5-7421	Telephone: Walnut 7796	Telephone: Broadway 4382	Telephone: Whitehall 3-0568



BEAVER RIVER BRIDGE

This 4,000-ton deck highway bridge consists of two 65′ beam spans; two 175′-6″ simple truss spans and one 3-span continuous truss, with spans measuring 321′-9″, 404′-6″ and 321′-9″ respectively.

ALLEGHENY RIVER BRIDGE

This 5,000-ton deck highway bridge consists of a 4-span continuous deck plate girder with spans 104′-4″, 130′-5″, 130′-5″ and 104′-4″; (469′-6″ c.c. of end bearings) and a 5-span cantilever and suspension type truss with spans 266′-8″, 346′-8″, 346′-8″, 533′-4″ and 213′-4″; (1706′-8″ c.c. of end bearings).

43 bridges

on western extension of Pennsylvania Turnpike

by American Bridge

THE structural steelwork for 43 bridges on the new sixty-seven mile extension of the Pennsylvania Turnpike was fabricated by American Bridge. American Bridge also erected 34 of these modern bridges, the two largest of which are shown above.

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There is no "tail swing" because the boom is the *only* part that revolves.

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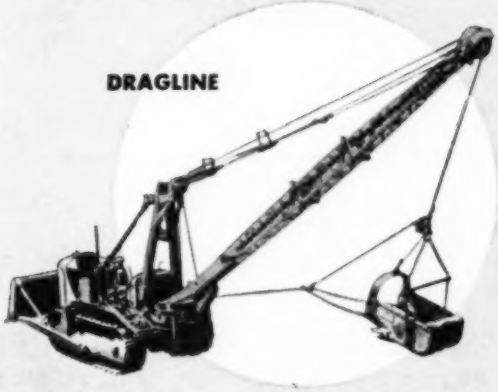

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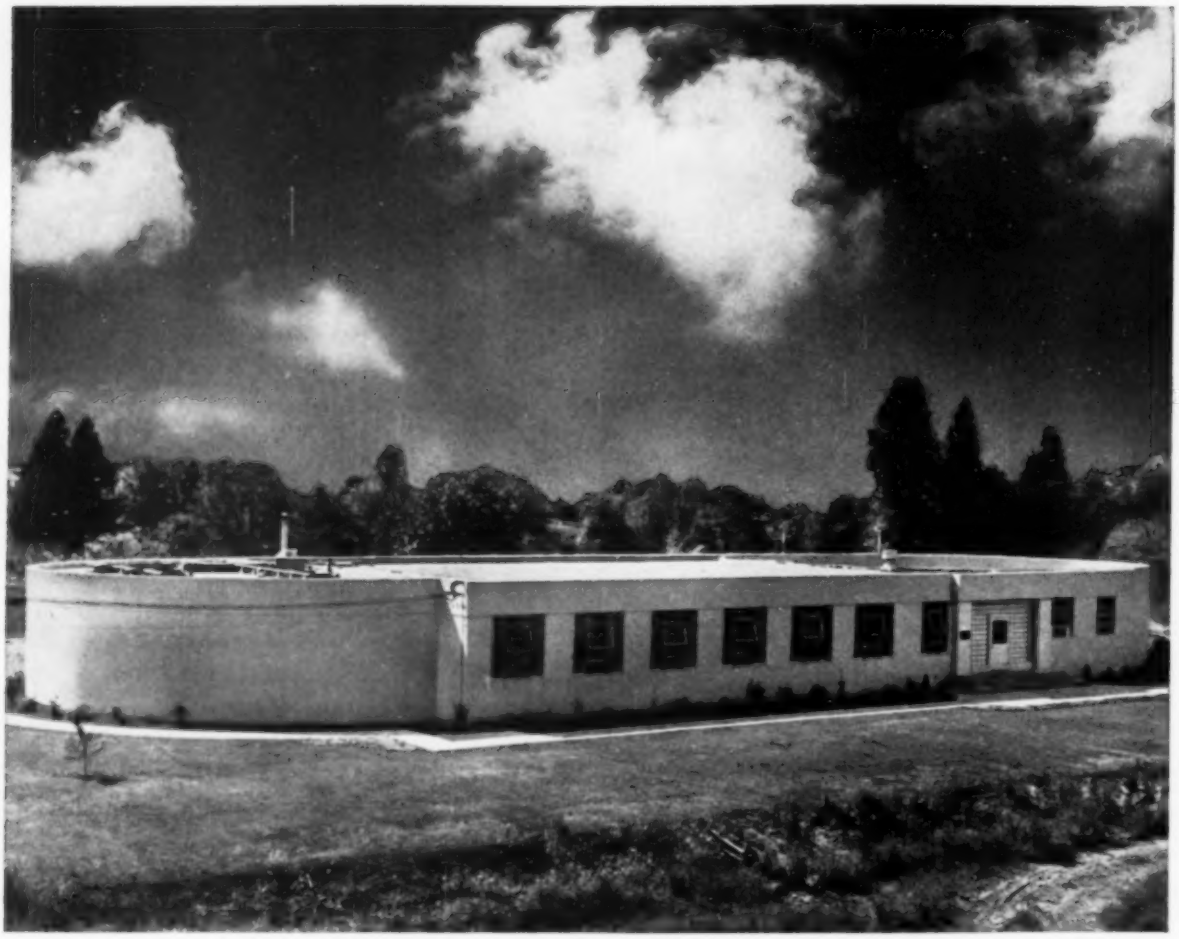

Build Functional and Distinctive Sewage Treatment Plants with Architectural Concrete

This sewage treatment plant in Centralia, Wash. exemplifies how architectural concrete combines functional qualities with distinctive appearance.

Centralia has a combined sanitary and storm sewer system. During the rainy season the sewage is given primary treatment only.

As a primary plant its capacity is 4½ m.g.d. and as a complete treatment plant 2 m.g.d.

Designers and engineers: Carey & Kramer, Seattle. Builder: A. G. Homann Co., Olympia.

Architectural concrete is an ideal construction material for sewage treatment plants. Its clean, neat appearance is a symbol of cleanliness and good municipal housekeeping. It makes the building a long-lasting asset and a source of community pride. It also offers:

1 UNUSUAL DURABILITY. It resists such destructive agents as severe weathering, fire, decay and sewage gases.

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3 REAL ECONOMY. Moderate first cost, low maintenance cost, long life = ***low annual cost.***

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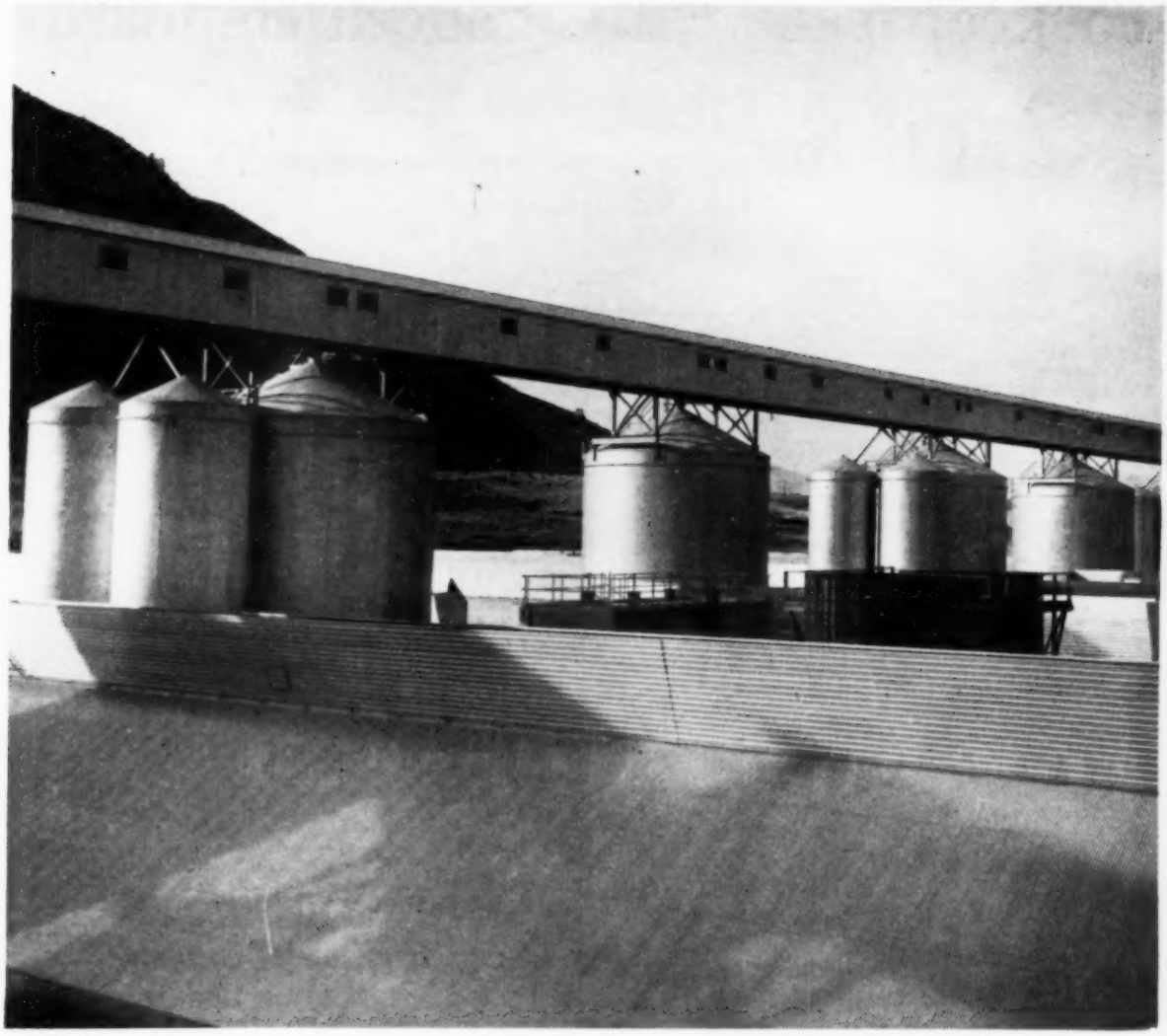

Storing Alumina and Cryolite at Wenatchee Smelter

Twenty-six tanks of various sizes and types were installed to provide storage facilities for alumina, cryolite, lime and other materials at the new Alcoa smelter at Wenatchee, Washington. The plant processes an average of thirteen carloads of raw materials per day and is capable of producing 170,000,000 pounds of aluminum ingots per year, consequently storage is an important item.

Nine welded steel tanks 38 ft. diam. by 64 ft. were installed for the storage of alumina—chemically refined bauxite from which the aluminum is smeltered. Storage for cryolite, a solvent used in the electrolytic smelting process, is provided by eight welded steel tanks 17 ft. diam. by 62 ft. 6 in. Other tanks, built by Chicago Bridge & Iron Company, are used to store lime, fuel oil, coke materials, etc.

In addition to flat-bottom tanks, we build spherical and spheroidal pressure tanks, cylindrical pressure vessels, and elevated water tanks. We design, fabricate and erect special structures of carbon steel or corrosion resistant materials. Our plants are fully equipped for x-raying and stress-relieving and we have facilities for pickling and painting fabricated steel plates by the Horton Phosphoric Acid Process.

We have four fabricating plants at Chicago, Salt Lake City, Birmingham and Greenville, Penna., to serve your needs. The next time you plan welded steel structures of any sort, write our nearest office for estimates or quotations. There is no obligation on your part.

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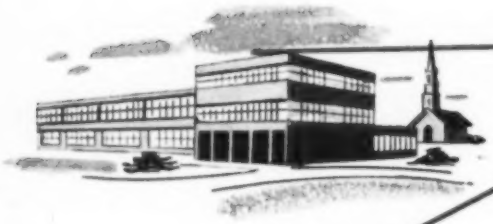

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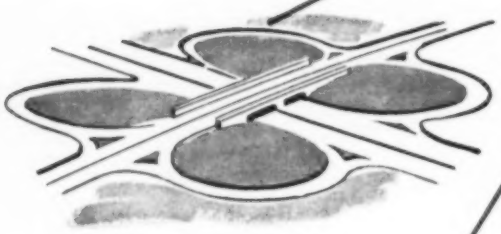
institutions, buildings

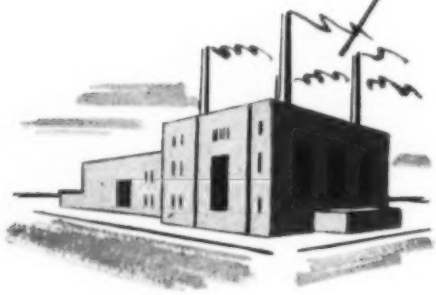
highways

basic community facilities



The Construction Industry has the immediate capacity

to build these essential projects wherever needed



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Cutting ditching hazards on the high seas and the highways

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THE LANDING OFFICER can guide the pilot to the air-craft carrier's deck, but he cannot *stop* the plane. To do that, a hook, attached to or near the plane's tail must engage one of the galvanized wire cables mounted on spring brackets, which are stretched across the deck. The resiliency of the wire cable, plus the action of the spring bracket, absorbs the shock of the plane's forward speed, helps stop it promptly, safely. American Multisafty Cable has proved so long lasting, effective and economical that it is being widely used for this purpose by the United States Navy.

WHEN a pilot lands his fighter on a flattop, a system of wire cables, attached to spring brackets, prevents him from "ditching" at the other end of the ship. And when a motorist goes off the road on a properly protected highway, a system of wire cables, attached to resilient brackets, can be designed to properly deflect the car even though the guard rail is hit at high speeds.

That is why Multisafty Cable Guard has been adopted as a standard material by many state highway commissions. The four galvanized wire cables, attached to galvanized spring brackets, absorb the impact of collision and sideswiping, prevent off-the-road crashes and capsizing of speeding cars.

Multisafty Cable Guard has been developed from many tests made at our Worcester, Massachusetts proving grounds where various guard rails were hit by automobiles at high speeds. Stresses in the rail were measured at time of impact. From these tests, data are now available to arrive at a rational method of designing highway guard for *definite miles per hour protection.*

When you are considering high-grade low-cost protection for highway traffic in your area, drop a line to our nearest sales office for complete information on Multisafty Cable Guard and for literature containing information on how to design a guard rail for *definite miles per hour protection.*

THE FOUR GALVANIZED wire cables of Multisafty Cable Guard possess the tremendous strength needed to withstand terrific impact. The offset spring brackets on which the cables are mounted help to absorb impact stresses and to deflect vehicles which collide with the guard. Posts and anchorages are sufficiently sturdy to withstand the total stresses transmitted by cables and springs. No painting is required, therefore, upkeep costs are low.

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UNITED STATES STEEL

Constructing a plant-mixed Texaco Asphalt pavement of the cold-laid type on Indiana State Highway 28 near Alexandria. Old pavement was widened and undersealed with asphalt. Contractor-Brooks Construction Co., Fort Wayne, Indiana

Indiana gives old highway a new intermediate-type Asphalt surface

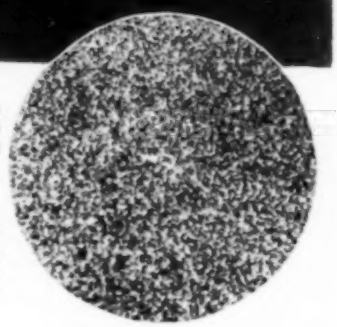
Indiana chose one of the intermediate types of asphalt construction when it modernized this section of State Route 28 last year. The new surface is of the plant-mixed, cold-laid type, in which a Texaco Rapid-curing Cutback Asphalt serves as binder for the broken stone aggregate. This surface was put down in two courses, with an interval of five days between courses for curing and setting up. A seal coat of RC Cutback, covered with chips, completed the new pavement.

This is another of the complete range of road and street types which Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils offer the road builder. These types vary in durability and in cost. Among them, you will find the answer to your own street, highway or airport improvement problem, with due consideration being given to traffic, available aggregate and budget limitations.

Whether used in a heavy-duty pavement or an inexpensive surface-treatment, Texaco Asphalt products deliver a consistently dependable performance, because they are refined from scientifically selected crudes and are backed by half a century of asphalt refining experience.

Helpful information about the various plant-mixed types of Texaco Asphalt paving, as well as those types in which Texaco products are applied by pressure distributor, is presented in two booklets which our nearest office will send you with no obligation on your part.

(*above*) Completed section of this intermediate type of Texaco Asphalt paving on Route 28.



(*right*) Close-up of the new pavement prior to application of the seal coat of Texaco RC Cutback Asphalt.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

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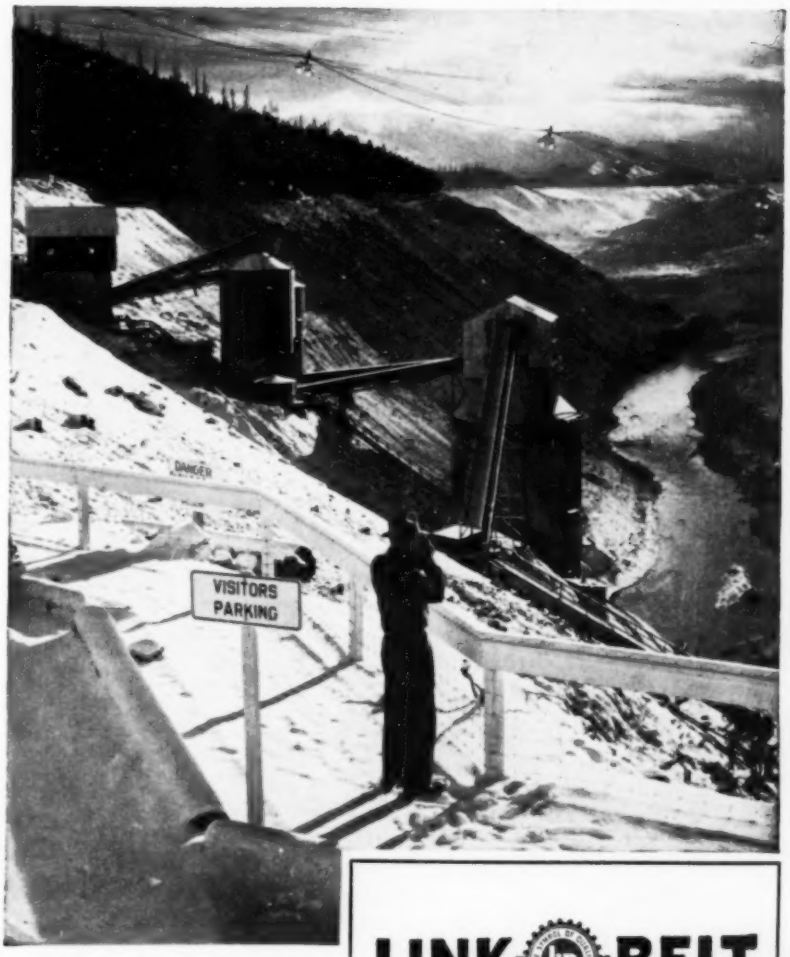
Link-Belt will gladly work with your engineers or consultants. Get in touch with your nearest Link-Belt office.



At Hungry Horse Dam, L-B belt conveyors at right carry sand and sized aggregate up mountainside to concrete mixing tower. Cement and pozzolan arrive by L-B belt conveyors from loading dock and silos at left.

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BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities.

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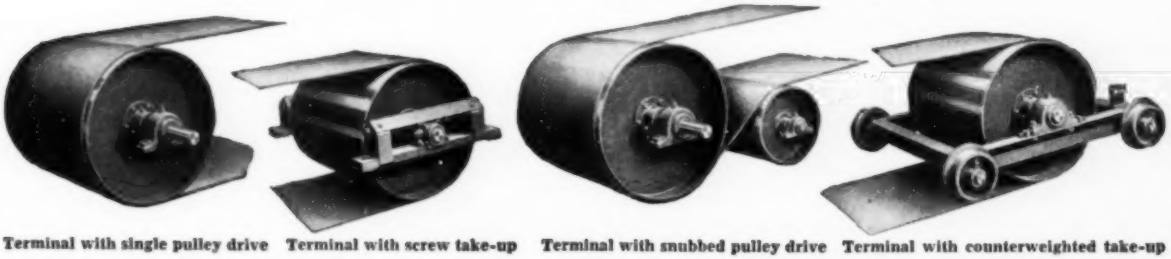

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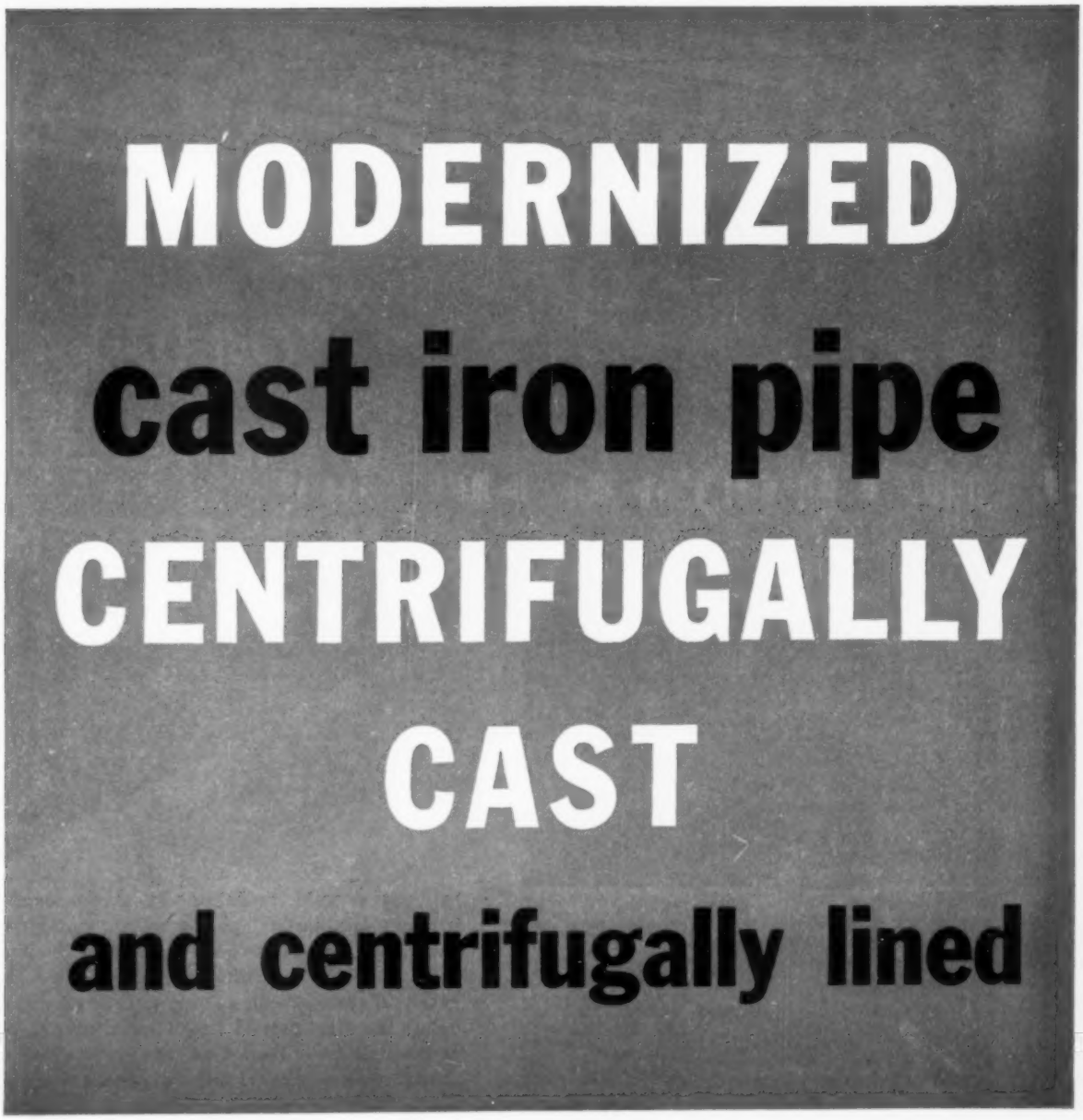

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Atlanta airport expansion job is scene of new triumph for International power

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One contractor, C. L. Rhodes of Decatur, Georgia, is doing the entire job, including cutting through a 39-foot hill and moving 350,000 cubic yards of sandy clay.

Rhodes' General Superintendent, R. N. Smith, tells how the work is going:

"We load quicker, haul faster and move more dirt with our Internationals than with any other crawlers.

"Our operators push 'em to the limit all day long to get the job done ahead of schedule. The tractors get clean filters, fuel and grease, and hard work—more hard work than is reasonable—and they take it month after month without a let down!"

That's what International owners everywhere are finding out. Find out for yourself. Ask your International Industrial Distributor for details.

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JOHNNY-ON-THE-SPOT SERVICE. A fast field service team from International's Atlanta distributor rolls up to the job site. Service like this from *your* International distributor is as near as your nearest telephone, to cut down downtime and keep your equipment rolling!

HIGH HEAPING FOR HIGH FLYING. Here are three of the five International crawlers that are furnishing power to extend runways at Fulton County Airport to increase the field's traffic potential.

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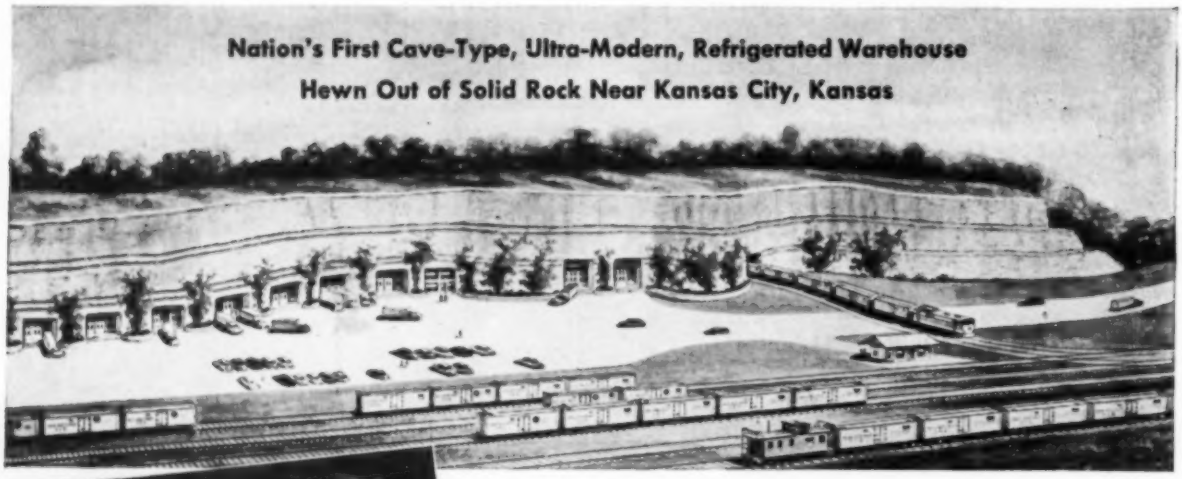
Nation's First Cave-Type, Ultra-Modern, Refrigerated Warehouse
Hewn Out of Solid Rock Near Kansas City, Kansas



● Hewn out of limestone rock, with 72-ft.-thick roof, 40-ft. spans between solid-rock columns, and entry through a vertical ledge of stone, NATURAL STORAGE COMPANY's warehouse at Coldspur, Kansas, on the Union Pacific, 17 miles west of Kansas City, is a Gibraltar-like answer to modern-age storage problems.

This previously-mined area of a limestone deposit provides ideal storage conditions, safely above flood, floors at ground level, no limit on floor loads, with 150,000 sq. ft. and 2½-million cu. ft. of storage space, and plans for expansion to ten-million cubic feet.

Suggesting the utilization of many other subterranean mined areas for safe storage of all kinds, this cave-type warehouse has year-around 55° F. temperature, serving as natural insulation for added refrigeration to chill or freeze meats, vegetables and fruits, in separate rooms.

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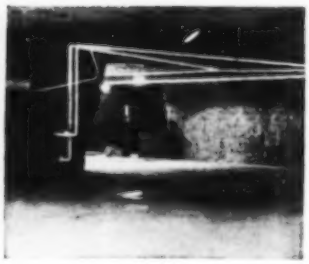

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Coldspur, Kansas

Floor Construction:
JOHN ROHRER CONTRACTING COMPANY

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CIVIL ENGINEERING

APRIL 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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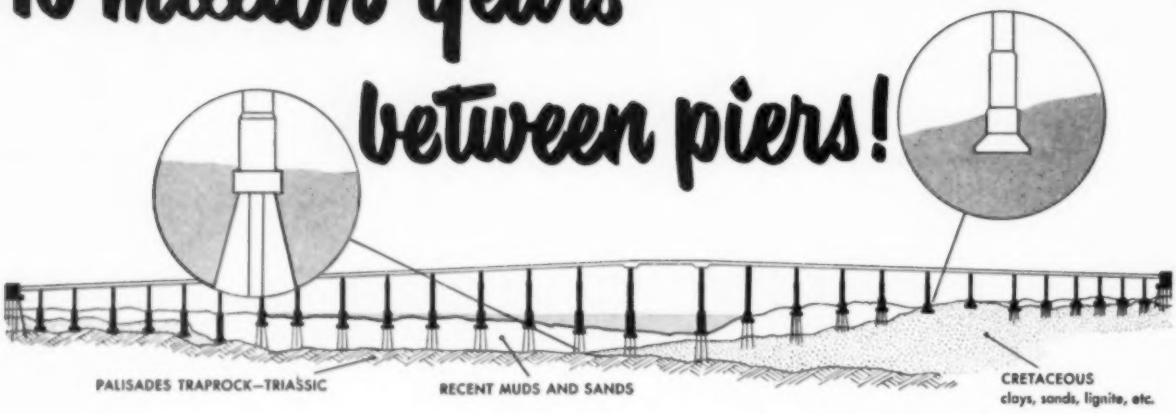
10 million years between piers!



NEW $11 MILLION RARITAN BRIDGE*

New Jersey's Garden State Parkway is being given a twin bridge over the Raritan River. The new companion bridge adjacent to the Edison Bridge built in 1939, is the Raritan Bridge shown above. The Edison Bridge was designed by Morris Goodkind, Bridge Engineer of the State Highway Dept. The new Raritan Bridge, very similar to the Edison Bridge, was designed by Dr. D. B. Steinman.

Foundations for piers 7 to 17 will be carried to bedrock . . . which is 10 million years older than the Cretaceous clays and sands supporting land piers 20 through 29. These strata have been consolidated by loading far in excess of the present overburden.

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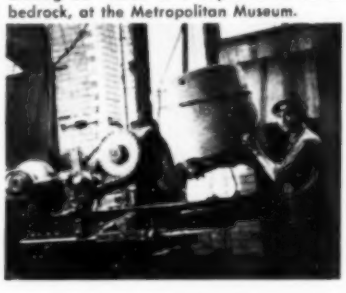

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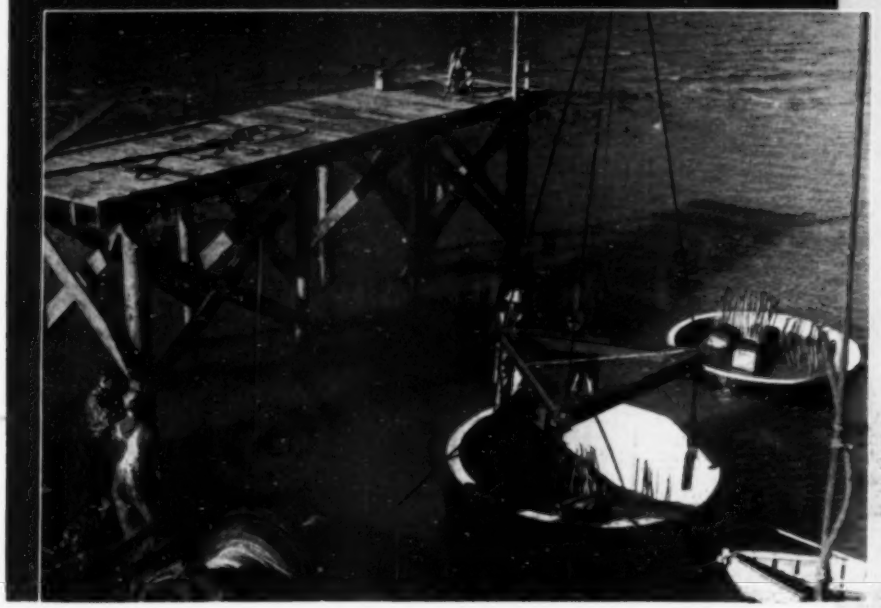


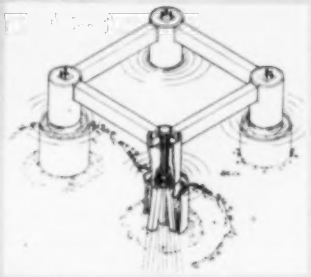


FIG. 1. Shallow-water piers are supported on battered concrete piles. Bottom shell is 12 ft in diameter and 11 ft high. Top shell is 8 ft in diameter and 12 ft high. Shell walls are 6 in. thick. Connecting girders were also precast concrete.

Bottom shell of shallow-water pier is set on sand-and-rock blanket. Heavy blanket was found necessary to prevent shell and tremie pour from sinking into soft mud of bottom. Note seated shell in background with concrete piles projecting above water.

Transmission-line piers built under water without cofferdams

BEN C. GERWICK, JR.
A.M. ASCE

Vice President, Ben C. Gerwick, Inc.
San Francisco, Calif.

The ingenious use of precast elements enabled the builders of the substructure for transmission lines crossing San Francisco Bay between Hayward and San Mateo to erect piers in both shallow and deep water without the use of cofferdams. The method permitted rapid construction whereby 19 major tower foundations were completed in six months.

The route of the transmission line runs across 2 miles of salt-evaporating ponds and 8 miles of San Francisco Bay, then turns north along the bay shore, where piers were built both in tidal mud-flats and in levee-protected lowlands. For the line location, see Fig. 1 of the article by Messrs. Raab and Tudor, p. 44.

The most interesting section is naturally that across San Francisco Bay, which forms the subject of this article. The main channel lies about one mile east of the west bank and is about 60 ft deep, with tidal currents ranging up to 7 knots. Except for this channel, which is less than a mile wide, the Bay crossing is in very shallow water. The tidal range is normally 8 ft but extremely high

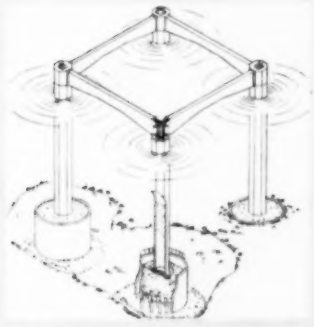


FIG. 2. Deep-water channel piers stand on untreated timber piles (23 per leg). Bottom shell is 19 ft across and 18 ft high. Precast shaft, 60 ft long and 7 ft across, stands on steel seat. Precast connecting girders weigh 50 tons each. Corrugated steel lip, 4 ft high, was added around bottom shell to prevent tidal scour of tremie concrete.

Shells for shallow-water piers were cast in contractor's permanent casting yard on Petaluma Creek on a navigable arm of San Francisco Bay. Shells in left foreground are for lower part of shallow piers and those in right foreground for upper part. Notches in right-hand shells will receive precast tie beams of finished pier. All precast units except piles were cold sprayed with a waterproofing bitumastic paint.

Shafts of main channel piers weighing 60 tons were precast at contractor's permanent yard (right). Permanent shaft reinforcing (above) was also fabricated in yard and placed inside shaft after it was in position.

tides may reach El.+10. The bottom is very soft, with 30 to 80 ft of mud overlying sand and sandy clays, although oyster shells throughout much of the mud help to give it some lateral stability.

The wide expanse of the Bay is exposed to winds and swells. Southeast winter storms strike on the western half of the job, while the eastern half is the target of northwest summer and winter blows. The shallow water seems to pile up the waves rather than to stop them, resulting in excessive wear and damage to boats and barges and difficulty in handling lines.

While the transmission line crossing lies just 113 ft south of the San Mateo highway bridge, overcrowded traffic conditions and the lack of sidewalks prevented the contractor from using this bridge for any purpose—even for surveying controls, or transportation of personnel. Thus the bridge actually was more of a hindrance than an asset, since it prevented use of adequate anchor lines to the north and restricted the mobility of floating equipment.

The design was controlled by the requirements of adequacy, economy, and speed of construction. The Pacific Gas and Electric Co. has long been a leader in the use of precast concrete and tremie concrete for underwater construction, and the San Francisco Bay area as a whole has seen many successful innovations and developments of these techniques. Therefore early consideration was given to the use of precast concrete and tremie concrete for the piers of this project.

Units Precast at Permanent Yard

All precasting was performed at the contractor's permanent yard at Petaluma Creek, on a navigable arm of San Francisco Bay. The precast units were delivered by barge to the site. Casting was performed on permanent concrete slabs and soffits, serviced by two gantry cranes, each having a span of 125 ft and a 75-ton capacity. Concrete was batched at the adjacent modern batching plant and transported and mixed in transit-mix trucks.

Each pier has four legs, to support the four legs of the transmission tower above. Spacing of the legs varies from 20 to 40 ft on the sides of the square. Each leg is supported independently, and the four legs are joined above water by heavy concrete girders.

Concrete Piles Support Shallow-Water Piers

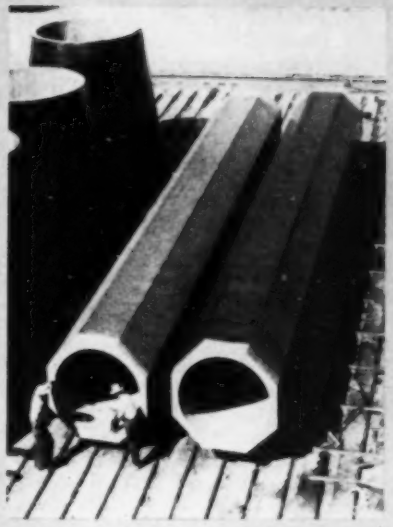
The shallow-water piers were designed with each leg supported by long precast concrete batter piles extending from the mud line down into the bearing strata. The pile heads are encased in a heavy concrete footing 12 ft in diamater and extending from El. −7 up to 4 ft above low water. From the top of the footing, a shaft 8 ft in diameter extends up to El. +13, where it is joined to the other legs by concrete girders. At the top of each shaft, heavy anchor bolts are provided to secure the steel transmission tower legs.

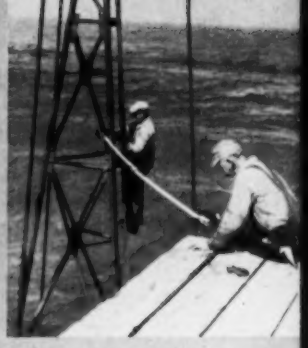
The entire pier is heavily reinforced, including the piles, to resist uplift. Precast concrete piles are ideal for this situation, because of their weight and because their skin friction provides good resistance to uplift. Since uplift is accompanied by lateral forces, piles were driven on a 2-in-12 batter in all four directions under each leg. This batter also helped to make up for the lack of lateral support from the soft mud in the top 30 to 80 ft of the pile penetration.

The precast concrete piles were 18 × 18 in. in cross-section, and from 40 to 108 ft in length. All were reinforced with eight 1-in.-dia bars, with $^3/_8$-in. stirrups on 6-in. centers.

Since these shallow-water piers were stretched out at 2,000-ft intervals across 7 miles of mud flats with an average elevation of −1, it was necessary to dredge a long channel to provide access for floating derricks and drivers, and for transportation of personnel, precast concrete units, and other materials. This channel was dredged 80 ft wide at the bottom, to an elevation of −7, and involved the removal of some 400,000 cu yd. Two large, long-boom, clamshell dredges were followed by another clamshell dredge that accurately dredged the site of each pier to grade (about El. −9).

The contractor used a very large floating pile driver, with a 108-ft





Lower shell of deep-water pier is set by 75-ton floating derrick using sighting tower, top of which projects above water beside timber-decked steel platform used for control. At right, workmen check position of control tower, which is bolted to lower shell of pier. When shell is in position, tower will be unbolted for use on next pier.

tower and 115-ft steel pendulum leads. Piles were driven with a No. 0 Vulcan hammer. To make matters more difficult, the longest piles were required in some of the shallowest water, which meant that a pile could not be lowered below the bottom of the barge while maneuvering to exact position. Therefore, a derrick was used to assist the driver and to pick up piles longer than 100 ft from the barge and place them in the driving leads. Once in exact position and batter, the pile was driven to approximately full penetration.

To control the location of piles and precast units, a platform was required in the immediate vicinity of each pier. Since the water was shallow, 8 untreated wood piles, heavily braced, with a timber decking on top, proved satisfactory and economical for this purpose.

Since the piles were battered in all four directions at each tower leg, the original plan was for the pendulum rig to drive the vertical center pile and the piles battered east and west only. Then these piles were girted with 6 × 12-in. timbers, and the derrick, using a set of steel swinging leads, set the north and south batter piles of the footing, resting them on the girts and driving them to grade. After several footings had been completed in this manner, so that the remaining concrete piles were 90 ft and less in length, the pendulum driver crew worked out a system of maneuvers whereby they drove all the piles, regardless of the direction of batter, without assistance from the derrick. Pile driving became more and more efficient, and was completed two weeks ahead of schedule.

Since there are 17 shallow-water piers, each with four legs, conventional construction would have required 68 cofferdams, 14 ft in diameter, and approximately 18 ft deep. Instead, precast concrete shells were used, as shown in Fig. 1. The bottom shells are 12 ft in diameter and 11 ft high, with 6-in. walls. A sand blanket or mat was placed around the projecting tops of the previously driven precast concrete piles and leveled off just above El. −7. Then the precast shell was set and, by means of an air-lift pump which removed sand from the inside, was lowered to exact grade. Alignment, position and level were checked from the control platform. Then the shell was filled with tremie concrete up to within 4 ft of the top. The crane on the front end of the concreting barge set up a steel frame on top of the shell. This frame held the tremie pipe, which was raised by an air tugger hoist. Then the crane charged the tremie pipe, and the pour was completed without the use of an additional derrick.

Concrete Seat Carefully Prepared

After the concrete had set, and when the tide was below El. +4 (the top of the 12-ft shell), the inside of the shell was pumped out and cleaned off. The tops of the concrete piles, which projected above the top of the tremie pour, were chipped clean and the projecting reinforcing steel was aligned and cleaned. Since an upper shaft was to be set on this lower concrete base, the seat area was chipped to exact grade and level. It was soon discovered that careful and exact performance of these incidental items of work, tedious and detailed and interrupted by tides as they were, was nevertheless more than compensated for when it came to setting the upper precast units.

The upper shaft shell, 8 ft in diameter and 12 ft high, with 6-in. walls and notches at the top for the connecting girders, was set by a floating derrick.

When all four upper shaft shells had been set, the derrick set the four connecting girders of precast concrete. These rested in the notches of the upper shaft shells, and were shimmed to exact grade. Then in the annular space between the 8-ft-dia upper shaft shell and the top 4 ft of the 12-ft-dia lower shell, a concrete seal was poured. The upper shaft shell was now pumped dry and the anchor bolt assembly set. The reinforcing bars of the shaft were welded to projecting bars from the girders, and the shaft was filled with concrete poured in the dry, thus completing the pier.

The precast-tremie method described above, worked out extremely well in the field, and all the pieces were fitted together without difficulty.

Accuracy in positioning and in preparing the seat for the upper shaft shell was found to be of prime importance. Because of the large number of similar piers, the economies of mass production were realized.

In setting and pouring the bottom shell one major difficulty was encountered which would have proved troublesome and costly regardless of the method followed. When the tremie concrete was poured, the mud bottom was so soft that a 2-ft tremie blanket settled down through it by the weight of the concrete alone. The solution proved to be the use of a much larger quantity of sand—to give a total thickness of 6 or 8 ft—with a 6-in. layer of crushed rock on top. It is my belief that this additional sand gripped the precast concrete piles and that most of the supporting value came from the piles. While this additional sand added to the cost, it did prove the most practicable and economical solution to the problem of supporting the tremie pour, and results were very satisfactory.

The elevation of the top of the bottom shell was established at +4, in order to allow work to be done at half tide, but because of the great tidal range at this location, this proved to be about 18 in. too low for the most economical operations.

Long Shafts Support Main Piers

Crossing the main ship channel presented the problems of a long span, combined with deep and swift water on both sides, and exposure to the maximum winds and waves present in San Francisco Bay.

The two major piers support the towers in the same way as do the shallow piers, each pier consisting of four legs or shafts, one at each corner of a 40-ft square (Fig. 2). The water is 50 to 60 ft deep at the sites of these two main-channel piers. Tidal currents range up to 7 knots. The bottom consists of 10 to 15 ft of soft clays overlying firmer clays, and immediately below this, a good bearing strata of sandy clay.

The scheme of construction developed for these two piers also was based on the use of precast units and tremie concrete. Each pier consists of four octagonal shafts approximately 7 ft across and 62 ft high, joined together above water by heavy concrete girders. Each shaft extends to the existing mud line, where it rests on a pier base 19 ft in diameter and 16 ft deep. This base in turn is supported by piling.

The procedure was to dredge some 15 to 20 ft of soft clay from each pier site down to relatively firm material. Then short, heavy, untreated, Douglas fir piles were driven into the bearing strata, using submarine leads from a large floating pile driver and an underwater hammer. The piles were cut off at an elevation 5 ft above the pier-base elevation by a diver using an air saw. There are 23 piles under each of the four legs. A sand mat was placed around the piles and leveled off at the elevation of the pier base.

Meanwhile, in the casting yard some 50 miles away on Petaluma Creek, precast concrete shells 19 ft in diameter, 8 in. thick and 16 ft high were cast on a barge. While the precast concrete shell was still at the casting yard, a cage of reinforcing steel was securely fastened inside it. In general, this reinforcing steel was radial, and turned up in the center so as to provide for a fixed connection to the shaft.

Secured to this steel cage at an elevation 12 ft above the bottom and 4 ft below the top of the shell, was a fabricated steel seat for the shaft. This seat was made of steel plate and consisted of a ring 1 ft wide, to match the shaft, with flared sides extending upward both inside and out to keep the tremie concrete from spilling over on the ring. These seats were quickly dubbed the "flying saucers" because of their peculiar shape and their size—roughly 9 ft in diameter.

To the under side of each ring, wire mesh and a 2-in.-thick coat of cement mortar were attached so as to insure good bond later with the tremie concrete. The purpose of these "flying saucers" was to provide a perfect seat for the shafts, and they were undoubtedly the key to the success of the scheme.

A barge load of four precast shells was towed to the site and set in place 60 ft or more below water. To enable this operation to be done accurately, a 60-ft-high steel-pipe sighting tower was temporarily bolted to the top of the shell. Then the shell, with the tower on top, was lifted from the barge by a 75-ton derrick and set on the sand blanket. Using the top of the sighting tower, now but a few feet above water, as a sight, the shell was adjusted to exact position. A diver with a jet helped lower the shell any place that the sand was a few inches too high. Then the sighting tower was unbolted by the diver and lifted clear, for use on the next shell (see photos, page 35).

At the casting yard, a 4-ft-high shield of corrugated iron was secured around the circumference of the top of the shell to prevent any possible scour of fresh tremie concrete. This shield was left permanently in place.

The next step was to fill the shell with structural tremie concrete. A 12-in.-dia tremie pipe suspended from a derrick was lowered through the center of the steel-shaft seat to a point just above the bottom, and the tremie concrete was poured from the floating concrete plant. Great care was used to raise the tremie pipe slowly and uniformly without any jerks, and to prevent loss of seal or disturbance of the concrete surface. In particular, the diver was careful not to walk on or otherwise disturb the surface. The tremie seal was poured to an elevation 6 in. above the shaft seat, which left the seat as a depressed ring.

After the tremie seal had gained strength, the precast concrete shafts were set. These shafts had been cast in a horizontal position in the casting yard. They were 62 ft long and 7 ft across, with 6-in. minimum wall thickness, lightly reinforced, and weighed 60 tons.

The shafts were loaded on a barge, towed to the site, and picked up with much the same scheme of rigging as is used in picking up a long precast concrete pile, using equalizer blocks to prevent excessive stress or deflection at any point. To prevent the lines from binding when the shaft was vertical, it was necessary to have a block of greater diameter than the shaft, in this case, 7 ft 6 in. Since no blocks of this size are made, four 16-in. sheaves were arranged on a structural steel frame on a semicircle of 7-ft 6-in. diameter, so as to act as one giant sheave. Because of the very heavy load, 1 3/4-in. steel cable slings were used.

Shafts Sealed Into Base

When the shafts had been lowered into position on the shaft seats, a tremie concrete seal was poured around the outside of the bottom of the shafts, filling the top 4 ft of the lower precast concrete shells.

Meanwhile, at the casting yard, the main-shaft reinforcing steel, consisting of forty 1 1/8-in. vertical bars in a circumferential ring, was tied and welded into a rigid unit. After delivery by barge to the site, the cages of steel were set inside the shafts, and the lower third of each shaft was filled with tremie concrete.

After this had set a few days, the top two-thirds of the shaft was pumped out and the construction joint prepared. The remainder of the shaft was filled with concrete poured in the dry through an elephant trunk. Actually, this breaking of the tremie pour part way up the shaft

is, in my opinion, unnecessary since tremie concrete poured all the way to the top would have been of at least as high quality, and the construction joint would have been eliminated.

One recommendation for any future use of this method would be to incorporate the main permanent reinforcing steel in the precast concrete shell of the shaft, which would eliminate the temporary reinforcing steel required for handling the precast shaft, and also eliminate the separate welding, transporting, and placing of the main-shaft steel cage. Further, although the bond of tremie concrete to reinforcing steel is excellent, the placing of the main steel in the hollow shaft at the time of precasting would allow for inspection before, during and after, and insure the best possible placement and bond.

When the four shafts had been poured to El. +5 above low water, they were joined by huge concrete girders. These girders were precast in the casting yard and were 46 ft long, 2 ft 6 in. wide, 7 ft high at the end haunches and 4 ft 6 in. high at the middle. They were very heavily reinforced and weighed 50 tons each. These girders were barged to the site and set by the 75-ton derrick with remarkable ease, in striking contrast to the elaborate falsework and forms that would have been required for cast-in-place concrete.

Here is a case in which reinforcing steel projecting from the ends of the girders, as designed, would interfere in the setting of the girders. So, in precasting, some of the bars were stopped just a foot beyond the ends of the girders, and after all four girders were set, the additional lengths required for embedment were welded on. All that remained was to set the anchor-bolt assemblies at each tower leg and to pour the final small plug of concrete in each shaft, securing the bolts and tying the shafts and girders together.

The practicability and economy of this scheme for deep-water piers can be most vividly shown by the fact that the actual number of working days required to complete one pier was only 30 after the site was dredged, and only 18 after the piles were driven and cut off and the sand mat placed.

Steel forms were used to precast the shallow-water shells and the casting was done on a large concrete slab. Lifting lugs were cast into the upper inside edge. Pouring was by means of a small, specially designed bucket, and both internal and external vibrators were used. Since there were 64 identical pier legs, maximum economy of forms was realized.

The eight shafts for the main channel piers were cast horizontally under the gantry. The outside was formed as an octagon and the inside as a circle. Temporary side windows were provided in the outside forms to facilitate pouring.

The eight bottom shells for these main piers, because they were too heavy for the gantries, were cast on a barge moored to a bulkhead at the casting yard. As stated before, the reinforcing steel cage and "flying saucer" shaft seat were set inside the precast lower shell at the yard.

All precast units except piles were painted with a waterproofing bitumastic paint, applied cold by spray.

Had construction time permitted, this project would have presented several excellent opportunities for using prestressed precast units. Since the precast concrete piles were designed to take uplift and would therefore be in tension at times, prestressed piles would be desirable if a successful method could be developed which would maintain the prestress in the reinforcing even though the pile heads had to be cut off. This would probably be done through bonding the prestressed steel rods, and providing positive mechanical anchors along the top 10 to 15 ft of the pile.

Precast shells and shafts could readily be prestressed circumferentially, but no real advantage would be gained, it is believed, since pressures during pouring are not large because of rapid setting of concrete.

Prestressing would have greatly reduced the size and dead weight of the precast girders and beams. But ordinary reinforcing steel would still have been required for tying into the shaft. And light-weight concrete would have reduced the dead weight if used either with normal or prestressed reinforcing.

Floating Concrete Plant Specially Designed

Job-site concrete was produced by a specially assembled, floating concrete plant. A large 1,000-ton barge was used to support the batching plant, cement silo, mixer, derrick (for charging the hoppers with aggregate and cement), and a crane for pouring. Deck engines, pumps, water tanks, fuel tanks and compressors were also installed.

The batching plant was a standard plant cut down in height and specially modified to keep the center of gravity as low as possible. Its measuring devices were specially mounted to give accurate measurements even when waves caused it to roll. The plant fed directly into a $1^1/_2$-cu yd single-drum paver, which in turn discharged into a concrete bucket. The bucket was handled by the crane for direct placement into the tremie pipes or forms.

Aggregates were brought in by barge from two sources on north San Francisco Bay. Water was delivered by a service barge with built-in water tanks.

Cement was trucked to the site in bulk in large steel cans holding 26 barrels each. These were then placed on the deck of the water barge and transported out to where the concrete plant was moored.

The job was serviced by five tugs. Communication was by voice radio on each tug, the office barge, and the two large derricks.

Under the project manager a superintendent-engineer was assigned to the west side piers, another to the east side or salt-pond piers, a third to the two channel piers, and a fourth to the shallow-water piers. One engineer was also assigned to the floating concrete plant. These, together with an office engineer, surveying crew, and office personnel completed the supervisory organization.

The design was prepared by the Engineering Department of the Pacific Gas and Electric Co. under the immediate direction of Carl Appleford, M. ASCE. Walter Dreyer, M. ASCE, is Chief Engineer and H. V. Lutge, M. ASCE, is Chief of Civil Engineering. The construction was under the direction of H. Haberkorn, A. M. ASCE, Engineer of Hydroelectric Construction, for the Pacific Gas and Electric Co., assisted by Stan Parker. A. J. Swank is manager of the General Construction Department.

Ben C. Gerwick, Inc., was general contractor for the substructure. The project manager for the contractor was Don Weaver. The adaptation of precast concrete units and tremie concrete to these piers was based on a method originally conceived by Ben C. Gerwick, Sr., A. M. ASCE, and this method was worked out in detail for the contractor by Mac Silvert, A.M. ASCE. Jack Weiss was in charge of all precasting operations at the casting yard.

(This article has been taken from the paper presented by Mr. Gerwick before the joint session of the Construction and Power Divisions at ASCE's San Francisco Convention. The session was presided over by A. H. Ayers, member of the Construction Division's Executive Committee. The complete paper is Convention Preprint 99.)

Centralized sludge treatment featured in San Francisco sewage plan

In December 1951, the City of San Francisco placed two new sewage treatment plants, the North Point and the Southeast, in operation. Although primary treatment of the sewage is accomplished at each plant, sludge processing for the two plants is done at the Southeast Plant, which receives sludge pumped six miles across town from the North Point Plant through a 10-in. cement-lined force main.

These plants, together with the Richmond-Sunset Plant which was completed in 1938 and enlarged in 1948, were constructed as part of a master plan having as its objective the treatment of all sewage discharged into the surrounding bay or ocean water. This master plan is based on a program recommended in a report to the Director of Public Works in 1935 by a Board of Consulting Engineers consisting of the late Harrison P. Eddy, M. ASCE, Charles Gilman Hyde, Hon. M. ASCE, Leon B. Reynolds, M. ASCE, and the late Clyde C. Kennedy, M. ASCE.

All three plants provide primary treatment of effluent with chlorination sufficient to reduce the number of coliform organisms in shore waters of recreational areas to less than 10 per milliliter for 80 percent of the time. (For the location of these three plants see the map, page 44.)

The Richmond-Sunset Plant is located on city property in the southwesterly part of Golden Gate Park adjacent to the main collecting sewer for the tributary districts. The effluent is discharged through this sewer to the ocean at the shore line. It was not necessary to extend the outfall beyond the shore as strong current and wave action at this location rapidly disperse and dilute the sewage. This plant is designed for a capacity of 20 mgd for sanitary flow, and a maximum capacity of 45 mgd for storm flow.

The North Point Plant is located adjacent to the outfall of the main collecting sewer of the North Point Sewerage District. Sewage is diverted from this main to the plant for treatment. The treated effluent is discharged approximately 900 ft offshore at a depth of 15 ft below low tide through four 48-in. cast-iron pipes. The design capacity of this plant is 65 mgd for sanitary flow and 150 mgd for maximum storm flow.

The Southeast Plant, which consists of a sewage treatment plant and a sludge processing plant, is located near Islais Creek. Here the effluent is being discharged temporarily into Islais Creek at the shore line. It is planned to extend the outfall to the bay shore in the future. This plant is designed for a capacity of 30 mgd for sanitary flow and a maximum capacity of 70 mgd for storm flow.

All units of the North Point and Southeast plants are housed for odor control because of their proximity to residential and industrial areas. Odor control is also maintained by prechlorination, by adding a deodorant of the chlorophyll or masking type to the ventilation system supply and exhaust air, and by adding a dilute cloroben solution to the screenings collecting cans to reduce odor.

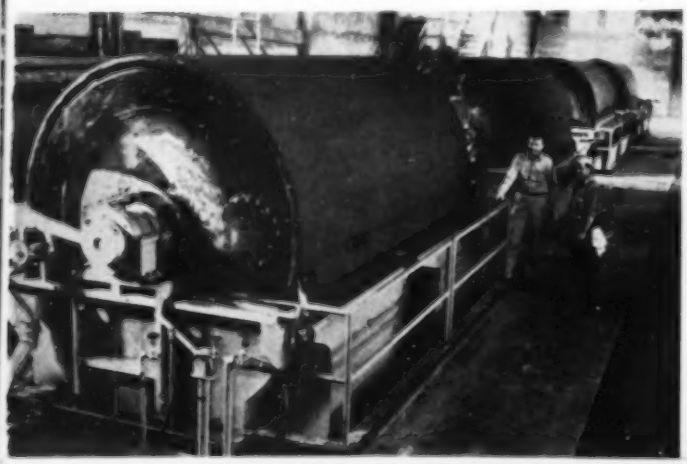
The raw sludge of low moisture content coming into the Southeast sludge processing plant, both from its own sewage treatment plant and from the North Point Plant, is thickened by plain settling in rectangular 2-hour holding tanks. The thickened sludge, with a moisture content of 4 to 5 percent, is drawn off the bottom and the overflow returned to the incoming sewage at the Southeast Plant. Grease is skimmed off by a special drag-type collector and is mixed with sludge before it is pumped to the digesters.

The control house for each group of three primary and two secondary digesters is centrally located so that all flows can be regulated in that structure (Fig. 1).

Facilities are available for single-stage elutriation between primary and secondary digestion to reduce digested sludge alkalinity and to improve secondary tank thickening; and for two-stage elutriation of digested sludge in separate tanks to reduce coagulant requirements in vacuum filtration.

Ferric chloride is used for sludge conditioning. It is delivered as a 45-percent solution in 1,500-gal tank trucks, discharged into a main storage tank, and is then pumped by rubber-lined pumps to daily storage tanks. The storage tanks feed by gravity to the mixing tanks immediately ahead of the filters where water is added and the mixture agitated for approximately 20 sec.

1



2

BEN BENAS, M. ASCE

Senior Civil Engineer
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San Francisco, Calif.

Photo courtesy of Pacific Flush-Tank Co.

Southeast sewage treatment plant is one of three plants built by San Francisco as part of its master plan for treatment of all sewage discharged into surrounding bay and ocean. Sludge treatment facilities in foreground handle sludge from both Southeast and North Point plants. Sludge from North Point plant is pumped 6 miles through 10-in. cement-lined force main.

The vacuum filters are provided with variable-speed agitators. The filter cake is dewatered by Combustion Engineering Co. flash dryers housed in a separate wing of the dryer building.

The dried-sludge handling facilities are in another wing of the dryer building. It is possible to feed dried material to storage, to the sacker, to the pelletizer, or to bulk loading; and from storage to the sacker, pelletizer or bulk loading; and to feed pelletized material to storage and then to the sacker or to bulk loading.

A dried-sludge pelletizer is provided to eliminate dust and to make a more granular material than is obtained by flash drying. During the first year of operation the pelletized, as well as the unpelletized, dried sludge was delivered to the city parks. Since January 1953, the dried sludge is being sold as is to a contractor on a short-term contract basis.

Provide 30-Day Test Period

Specifications required the City of San Francisco to furnish the operating staff, water, power, and chemicals to place the plants in operation for a 30-day test period after completion of the preliminary tests. During the 30-day test period the contractors were required to instruct and supervise the operating staff in the care and operation of equipment, to make any changes necessary to comply with specifications and to replace any defective material. The contractors assumed all responsibility for any damage to plant or equipment during this period.

The starting of the digestion system at the Southeast Plant is of special interest. One primary digester was seeded with 1 million gal of digested sludge hauled from the Richmond-Sunset Plant in 5,200-gal tank trucks during a 30-day period. In November 1951, before adding the seeding material, the digester was filled with fresh water and heated to 95 deg F. When 500,000 gal of seeding material had accumulated in the digester, raw sludge was added in an amount equal to 10 percent of the solids loading in the digester. This ratio was maintained as the amount of solids in the digester increased. The supernatant and some bottom sludge from the seeded digester were transferred to the other two primaries and raw sludge added until all three

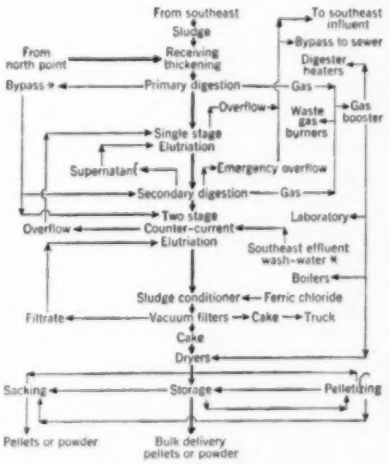
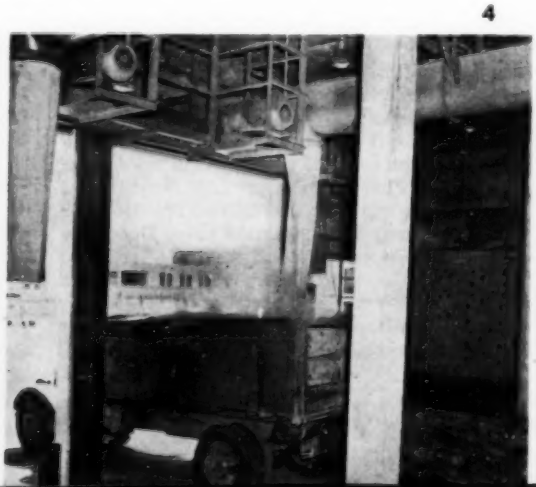


FIG. 1. Sludge flow diagram shows complete operation of Southeast plant. Note initial sludge thickening by plain settling.

3

4



Sludge drying facilities in Southeast Plant include vacuum filters with variable-feed agitators 8 ft in diameter and 14 ft long (photo 1); cage mills of dryers, which remove 6,250 lb of water per hour (2); and 3-ton-per hour pellet mill (3). Dried sludge not pelletized is being loaded into truck (4). Pelletizing to reduce dust, seen rising from truck, is now being tested.

digesters were functioning. Thirty days after seeding began, a total of 60,000 lb of raw sludge was being added to the three digesters daily.

Gas production reached 125,000 cu ft per 24 hours, six days after feeding with raw sludge, and thereafter the amount of gas production reflected the load of raw sludge added to the digesters. After February 15, 1952, digester gas was used for heating the digester and dryers.

Starting in March 1952, supernatant and bottom sludge from the primary digesters were transferred to the secondary digesters with intermediate single-stage elutriation. By the middle of April there was sufficient storage of digested sludge to permit operation of one dryer at rated capacity for thirty days for test purposes. During this time digester conditions were checked by determination of volatile acids, alkalinity, volatile matter, pH, and composition of gas.

During March the Sewage and Water Treatment Division, in cooperation with representatives of the filter manufacturer, checked all auxiliary equipment of the filters to make sure it was operable. Then the filter drums were soaked by revolving continuously in a bath of water for 186 hours, and the filter cloths installed. Production of filter cake, using elutriated sludge, was started in April and continued on an intermittent basis in order to check and adjust secondary elutriation, filtration and conveying equipment under operating conditions; to insure a steady and adequate supply of filter cake for drying; and to determine the nature of the filter cake produced.

After one week of tests the filters were operating satisfactorily and it was possible to start the dryer tests. The dryers were first tested for operation and then for performance. Before initial operation, the representative of the manufacturer made a check of the installation and assisted in the training and instruction of plant personnel. During the operational tests all components of the system were checked and adjusted, proper operating procedures were developed for starting and stopping the dryers and for coordinating filter and dryer operation.

The dryers were then shut down for two weeks to make final detailed inspection of the equipment, and to check the brick work in the furnaces and in the connecting ducts for deposits. A final performance test was then made on each dryer to determine the water evaporation capacity, total horsepower required and BTU per ton of dried solids. All dried-sludge handling facilities were operated and checked during the dryer tests.

Operating Problems Solved

Some sand accumulations were found in the primary digesters after the initial operation. This condition was corrected by withdrawing the bottom sludge and recirculating it back at higher levels. This practice has been continued for all primary digesters and has resulted in keeping the lines clear by materially reducing the quantity of sand.

The feeding of ferric chloride to the filters has been changed from a constant-feed orifice at the daily solution tanks to a controlled feed at the filters. The feed is regulated by a measuring device which may be varied by adjusting a regulating clamp on the ferric chloride feed line. The ferric chloride mixed with diluting water is fed into the incoming sludge at the top of the mixer and the mixed sludge is discharged from the bottom. This method gives more uniform results than bottom feeding and top discharge.

Changes to obtain better quantity control are proposed in the present methods of feeding dried sludge from storage to the sacker, pelletizer and to bulk loading at the Southeast Plant.

The dust problem in handling dried sludge is giving much concern. Studies are being made for its elimination by the use of additives, better ventilation, and so on, but no definite solution is indicated at this time.

The pelletizing of dried sludge is a new process for sewage treatment, although this method has been used successfully for many years for processing food such as cattle feeds. Pelletizing equipment was installed to produce a more granular product and to reduce the dust. From our present experience it is seen that it is possible to pelletize dried sludge, but the dies wear out rapidly due to its gritty nature. Experiments are being conducted by the plant on the effect of moisture, and by the manufacturer to determine the proper material for the die and the effect of the shape of the openings. It will take considerable time before solutions to these problems are reached.

The sludge-processing facilities at the Southeast Plant have been in continuous operation since December 1951 except for minor shutdowns of the filters and dryers to conform to delivery requirements. There is sufficient capacity in the digesters for storing sludge during shutdown periods. An average of 65,000 lb of dry solids per day of thickened sludge with a 95-percent moisture content and 65.5-percent volatile from the North Point Plant, together with 20,000 lb from the Southeast Plant, were transferred to the digesters.

City water was used for elutriation before the sewage-treatment facilities of the Southeast Plant went into operation in November 1952. During this time digested sludge averaging 9.8-percent solids and 41-percent volatile was elutriated and then filtered at an average rate of 4 lb of dry solids per sq ft of filter area. An average of 2.5-percent ferric chloride, based on dry solids, was used as a coagulant, producing filter cake with a moisture content varying from 61 to 68 percent. The percentage of ferric chloride required has been increased by 1 percent since the plant effluent from the Southeast Plant is being used as elutriating water.

The dryers evaporate from 5,000 to 6,500 lb of water per hour and produce an average of 3,500 lb of dried sludge with a moisture content of 8 to 10.5 percent. At times the moisture content of the dried sludge has been increased to 12 to 14 percent in order to determine the effect on the operation of the pellet mill and to determine whether the material is less dusty. No figures are available on the pellet-mill operation at this time as the equipment has been operated intermittently.

Gas production from the digesters averaged 420,000 cu ft daily during the summer months.

Our results to date indicate that the plants are performing the functions for which they were designed. When all of the connecting lines are completed and no raw sewage is being discharged to the bay or ocean waters, San Francisco will have taken a major step forward in improving sanitary conditions and in making the shores and shore waters available for recreational and other uses.

The plants are under the supervision of the Sewage and Water Treatment Division of the Bureau of Engineering, Department of Public Works of San Francisco. Sherman P. Duckel, A.M. ASCE, is Director of Public Works, Ralph G. Wadsworth, M. ASCE, is City Engineer, and Reuben H. Owens, A.M. ASCE, is Senior Engineer of Design.

(This article is based on the paper presented by Mr. Benas before the Sanitary Engineering Division session presided over by Erman A. Pearson, chairman of the San Francisco Section's Sanitary Engineering Committee, at the San Francisco Convention of ASCE.)

California proposes diversion of Feather River water to southern California

A. D. EDMONSTON, M. ASCE, State Engineer, Sacramento, Calif.

Need for review of California's Water Plan led the state legislature in 1947 to provide funds for the statewide investigations now being conducted by the Division of Water Resources under the direction of the State Water Resources Board. The objective was the preparation of a plan for the full control and utilization of the state's water resources, to be known as "The California Water Plan." These investigations have now progressed to the point where some general conclusions can be presented.

Perhaps the most interesting conclusion drawn from the inventory of water resources and requirements so far made is that adequate supplies can be developed from California's own water resources (including its rights in the waters of the Colorado River) to meet the probable ultimate needs of the state without importing water from sources outside the state, such as the Columbia River.

In each main area of the state a comparison was made between the ultimate water requirements of the area and the supplies available therein. It was found that in the north and central coast areas and the Sacramento River basin, water in excess of ultimate needs is available. On the other hand, in the San Francisco Bay area, the San Joaquin River basin, and the areas east of the Sierra Nevada and south of the Tehachapi Mountains, ultimate requirements are far in excess of local supplies.

Obviously, in any comprehensive plan for the utilization of the water resources of the state, water must be transferred from areas of surplus supply to those of deficient supply. The areas from which surpluses must come are the Sacramento River basin and the north coast. One unit of the plan for transfer of surplus water to areas of deficient supply is shown in Figs. 1 and 2. In the narrow coastal area south of the Big Sur on the Monterey Peninsula there is also a surplus, but it is relatively small in total quantity and the area is lacking in suitable reservoir sites.

On the other hand, there are many feasible reservoir sites in the north coast area and in the Sacramento River basin. In the north coast area, more than 50 dam and reservoir sites have been found which are physically capable of storing up to a total of 16,000,000 acre-ft and producing more than 2,000,000 kw of electric power, an amount almost equal to all the present hydroelectric power installations in the state. In the Sacramento River basin, more than 40 feasible reservoir sites have been found, capable of storing more than 15,000,000 acre-ft of water. Such installations will not only meet the ultimate requirements of the two areas in which they are located but also will provide surplus water for areas of deficient supply.

The general plan being considered for the development of the water resources of the north coastal area calls for the construction of a series of multiple-purpose reservoirs of relatively large capacity on the major stream systems which have relatively low gradients and widely varying seasonal flow. A hydroelectric power plant would be located at each dam. The reservoirs would be operated for water conservation, flood control, power generation, and maintenance of stream flow for propagation and maintenance of fish life, recreation, and to provide surplus water for exportation to areas of deficient supply.

Oroville Reservoir on Feather River

In the Sacramento River basin, the reservoirs would be operated to provide water for domestic, municipal and irrigation uses, navigation, flood control, electric power generation, recreation, and propagation and maintenance of fish life. One for which studies have been made is the Oroville Reservoir on the Feather River, shown in Fig. 1. Its proposed capacity of 3,500,000 acre-ft would require a dam 710 ft high. There would be a 440,000-kw power plant below the dam and an afterbay dam $4\frac{1}{2}$ miles downstream for reregulation of power releases. Another power plant of 25,000-kw capacity would be located below this afterbay dam. Transmission lines with three 230-kv circuits would be required to transmit the energy to a load center near Bethany in Contra Costa County. A cross-channel would also be re-

FIG. 1. Project estimated to cost 1 ¼ billion dollars involves storage and transportation by gravity and pump lifts of 2.7 million acre-ft of water annually to San Joaquin Valley and southern California.

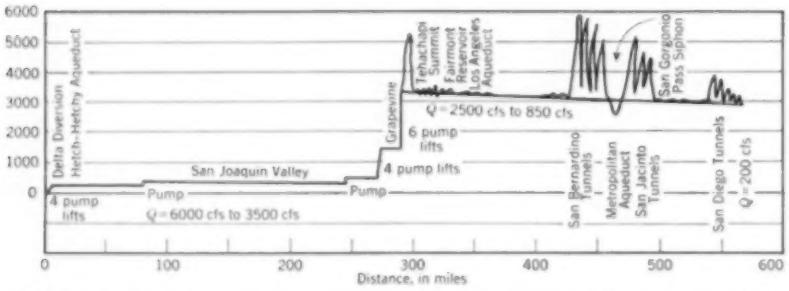


FIG. 2. Canals, siphons, pumping plants, and tunnels make up 567-mile length of California's proposed conduit to transport water from areas of excess to areas of deficiency within the state.

quired to convey project water into and across the Sacramento–San Joaquin delta.

Studies recently made indicate that 600,000 acre-ft of surplus water monthly is available in the channels of the Sacramento–San Joaquin delta for a period of five to eight months of the year. With the Oroville Reservoir operated for flood control and to supply water for all requirements in the Feather River service area, sufficient releases could be made to supplement these surplus waters to permit a constant diversion from the delta of 3,930 cfs, equal to 2,845,000 acre-ft annually. At the same time an average of 1¾ billion kwhr of electric power would be generated annually.

The estimated cost, in May 1951, of the dams, reservoirs, power plants, transmission lines and the delta cross-channel in the Feather River development, was $444,813,000.

Santa Clara-Alameda Diversion

The plan proposed for serving the areas of deficiency would divert water from the Sacramento–San Joaquin delta, the central source of supply, at sea level. (See Fig. 2.) For the San Francisco Bay area—an area of deficiency—the point of diversion would be on Old River near the Alameda–Contra Costa County line. The water would be lifted by pumping to an elevation of about 720 ft, and conveyed through the Coast Range in a tunnel about 7,000 ft long into Livermore Valley. From the tunnel a pipe pressure conduit would follow the north side of the valley to a point about four miles northwest of Livermore, where it would separate into two branch conduits. One branch would run southward, serving the south Bay Shore area of Alameda County and the east side of the Santa Clara Valley, with a 6,000 acre-ft terminal storage reservoir near Evergreen, 7 miles east of San José, and a 20,000 acre-ft storage reservoir about three miles east of Milpitas. The other branch would bear westward to a reservoir in Crow Canyon with a capacity of 16,000 acre-ft, to deliver supplementary water to the central Bay Shore area of Alameda County.

Additional water, if desired, could be supplied to the Upper San Leandro and San Pablo reservoirs of the East Bay Municipal Utility District and to areas in Contra Costa County through extensions of this branch. Supplemental water could be made available from the conveyance system to Livermore Valley and the Niles Cone. The distances from the intake on Old River are approximately 52 miles to the terminal reservoir site near Evergreen and approximately 29 miles to the Crow Canyon site.

The estimated cost, in May 1951, of the Santa Clara–Alameda diversion, to supply 127,000 acre-ft annually, was $31,065,000.

San Joaquin Valley–Southern California Diversion

A conduit to serve the areas on the west side and in the southern end of the San Joaquin Valley, and areas south of Tehachapi, would divert from Old River in the San Joaquin delta. Water would be lifted to a canal, at El. 225 ft, which would parallel the Delta-Mendota Canal of the Central Valley Project (El. 200 ft) to a point near the south line of Merced County, where a pumping plant would lift the water to El. 400 ft.

The canal would then follow approximately on grade contour along the west side of the San Joaquin Valley to the Buena Vista Hills, where another pumping plant would lift the water to El. 500 ft. Four

additional pumping lifts and a canal would deliver the water to Pastoria Creek, 3 miles east of Grapevine, at El. 1,500 ft.

A pumping lift introduced at this point would raise the water to El. 3,375 ft, to the portal of the first of two tunnels, aggregating 10.5 miles in length, which would convey the water through the Tehachapi Mountains to the divide between the Santa Clara River Basin and the desert.

The conduit would then extend along the westerly edge of the Antelope Valley on the desert side of the mountains, passing about 290 ft in elevation above the Fairmont Reservoir on the Los Angeles Aqueduct. It would cross Amargosa Creek and follow the south side of that creek, passing about 470 ft in elevation above the Palmdale Reservoir, and cross Soledad Pass at Vincent and Little Rock Creek below the Little Rock–Palmdale Dam. The course of the conduit would then be easterly across the Mojave Desert to the portal of a 3-mile tunnel on the headwaters of the Mojave River at El. 3,260 ft, which would terminate in Devils Canyon, a tributary of the Santa Ana River and a source of water supply for the City of San Bernardino.

Thence the conduit would proceed in a series of tunnels following the south slope of the mountains north of San Bernardino and Redlands, running southerly to a siphon across the San Gorgonio Pass between Beaumont and Banning. It would then bear southward, mostly in tunnels, along the mountains east of the San Jacinto Valley, passing above Lake Henshaw on the San Luis Rey River, and crossing the headwaters of the San Diego and Sweetwater rivers, to a terminus at a tributary of the Tia Juana River at El. 2,850 ft. The total length of the conduit would be about 567 miles from the point of diversion in the San Joaquin delta. Its estimated cost, in May 1951, was $794,500,000.

Santa Barbara–Ventura Diversion

A conduit route that would serve the deficiency area in Santa Barbara, Ventura, and part of San Luis Obispo counties has also been studied. At a point on the main conduit about 250 miles from the diversion point in the San Joaquin delta a series of pumping plants could lift water from the San Joaquin Valley–Southern California diversion conduit in the vicinity of Cienaga Canyon near Maricopa, over the divide at El. 3,000 ft into Cuyama Valley. With additional conduits, water could be delivered from this point to the headwaters of the Santa Ynez River through Mono Creek, and to Ventura River through Matilija Creek.

Initial Accomplishments Projected

In connection with the delivery of water from the conduit, hydroelectric power could be developed at several points on the Pacific slope of southern California.

The estimated ultimate annual supplemental water supplies that would have to be diverted from the delta in accord with this plan are: 2,000,000 acre-ft for about 1,000,000 acres on the west and south sides of the San Joaquin Valley; 2,500,000 acre-ft for the south Pacific Coast area; and 2,500,000 acre-ft for the desert area, or a total of 7,000,000 acre-ft. Of this amount, the Oroville Reservoir, in conjunction with the surplus water in the Sacramento–San Joaquin delta, could make available a firm supply of 2,718,000 acre-ft per year on a constant-flow basis. This would amount to about 226,000 acre-ft per month and would be in addition to the 127,000 acre-ft per year (or 10,600 acre-ft per month) available for diversion to Santa Clara and Alameda counties. To furnish the full 7,000,000 acre-ft of water, additional storage capacity would be required in the Sacramento River basin or in the north coastal area, and the works of the project would have to be enlarged.

The objective of the plan described above for conveying water to southern California would be to furnish water as needed to supplement existing supplies, including California's rights (5,362,000 acre-ft annually) to the waters of the Colorado River, presently available to the areas south of Tehachapi, and must be considered as an *additional* and not a *substitutional* supply for the areas to be served.

The plan of utilizing the Sacramento–San Joaquin Delta as the source of supply and point of diversion has many practical advantages. The point of diversion is below all riparian owners and users of water in the basin above the delta and therefore is not subject to objection by such owners. The delta channels receive all the inflows, including return waters, from an area of about 50,000 sq miles. The supply to the delta therefore is not dependent on the vagaries of a single stream. Water developed in any part of the Sacramento or San Joaquin River basins could find its way by gravity to the delta, and the same is true of surplus water that would be transferred from the north coastal area to the Sacramento River basin.

Additional advantages of the plan are that the conduit to the San Joaquin Valley and southern California would largely traverse undeveloped terrain, would not interfere with the operation of existing water supply systems, would not involve any exchange of waters, and would be so located as to furnish by gravity from the conduit additional water supplies to existing systems and to new areas capable of development and in need of water. It is feasible of construction from both engineering and geological standpoints and, it is believed, would have a first cost less than that of any other plan. It would be capable of supplying a complete supplemental water supply for the full development of the west and southern sides of the Upper San Joaquin Valley, the south coastal area, and the desert areas in Los Angeles, San Bernardino, and Riverside counties.

The foregoing plans are presented as possible units of the California Water Plan now being evolved by the State Engineer under the direction of the State Water Resources Board.

An Act of the Legislature in 1951 directed the Department of Public Works, acting through the State Engineer, to conduct the necessary investigations, surveys and studies and the preparation of plans and specifications for construction of the Feather River and Sacramento–San Joaquin Delta Diversion Project works as authorized, and submit them to the Water Project Authority for approval. The 1952 Legislature appropriated $800,000 for such work and it is now under way.

Sea Water Source Also Studied

Recent technological advances have called attention to sea water conversion and cloud seeding as possible means of adding to California's water resources. Similarly, reclamation of sewage and waste waters for beneficial use, which already has been accomplished in certain instances, is under discussion and investigation.

(This article has been prepared from the paper—Convention Preprint 94—presented by Mr. Edmonston at the ASCE San Francisco Convention, before an Irrigation and Drainage Division session, presided over by Harry F. Blaney, a member of the Division's Executive Committee.)

EDITOR'S NOTE: A proposal with a similar objective was described by S. P. McCasland, M. ASCE, in his article, "Water from Pacific Northwest for Deserts of Southwest," CIVIL ENGINEERING, Feb. 1952, p. 45.

Economic studies determine location and

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FIG. 1. Richmond-San Rafael Bridge, on which work was started in March, is most recent of various crossings of San Francisco Bay.

FIG. 2. Economic studies were made of seven locations for Richmond-San Rafael Bridge before Route C was finally chosen. Factors which influenced selection are listed in Table I.

The Richmond-San Rafael Bridge is a $62,000,000 six-lane highway crossing of the northern arm of San Francisco Bay (Fig. 1). It will join the two cities from which it derives its name, replacing the ferry, which has become increasingly less adequate in recent years. A bridge in this vicinity has been intermittently proposed for the past quarter of a century, and has been under intensive study since July 1950. Completion of the project, with one deck 36 ft wide, is scheduled for July 1956. Later, when traffic justifies, a second and lower deck of the same width will be added.

The bridge is a large project but not record-breaking in any particular. The over-water portion will be 4.1 miles long. The principal elements are two separate cantilevers each with a main span of 1,070 ft. One of these crosses the primary navigation channel and provides a minimum vertical clearance of 185 ft. The second crosses a secondary navigable channel near the eastern shore and provides a 135-ft minimum vertical clearance. The remainder of the bridge is made up of 289-ft steel trusses and 100-ft steel girder spans. Adequate approaches will be provided at both ends. The toll plaza and an administration building will be built at the Richmond (east) approach.

The bridge is being built by the California Toll Bridge Authority and financed by revenue bonds. The sole security for the payment of interest and principal on these bonds is the tolls to be collected from vehicles using the structure. Maintenance and operation costs are also to be paid from tolls. The first bond issue is $62,000,000, which will cover the cost of construction with one deck only ($50,000,000); interest during construction plus six months ($10,000,000); and a construction reserve ($2,000,000). When required, an additional $10,000,000 of bonds will be sold to cover the cost of a second deck and necessary expansion of approaches and related facilities.

When studies for the Richmond-San Rafael Bridge were first undertaken it was not at all evident what location would be best for the structure. Seven different sites were studied in detail, and not until all of the economic and other factors had been considered was it possible to ascertain that an alignment generally following the ferry route would be best. This is Route C, Fig. 2.

At the time the studies were started there was only meager information available on subsurface conditions. Therefore a broad exploration of the whole area was made first. This disclosed that in general the depth of water does not exceed 50 or 60 ft; that an upper layer of soft mud averaging about 50 ft in depth, which is incapable of supporting anything but small loads, is characteristic of all proposed locations; and that below this mud the load-supporting qualities of the materials improves with depth. For the sites considered it was determined that adequate support for steel piles could be found at reasonable depths. Rock is not available except near the shores.

These investigations indicated that no particular location has any advantage as far as foundation conditions are concerned.

The topography of the east shore proved to be of some importance in the selection of a site. All the A and B sites anticipated the use of the Point San Pablo peninsula. Perhaps if there had been no other competing use for this peninsula, a good approach alignment could have been developed on it. However, the topography of the peninsula is quite rugged and it has a maximum elevation of over 400 ft. This has made it an excellent site for oil storage tanks for a large nearby refinery and for the Navy. Little room is left for an approach highway so that it would be costly and have grades up to 5.0 percent. The C and D locations avoided these difficulties on the east shore.

The A, A-1, and D alignments encountered some fairly rugged topography for approaches on the west shore. The B, B-1, B-2 and C alignments offered substantially more favorable conditions. Considering the topography on both shores, the C alignment has much in its favor.

The provision of satisfactory clearances for navigation posed some unanticipated problems. It was found that the relatively narrow passage

design of Richmond–San Rafael Bridge

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between Points San Pablo and San Pedro creates strong tidal currents. Furthermore, the navigable channel alters direction just north of these points. These conditions are often complicated by dense fog. Consequently navigation interests strongly favored alignments C or D and opposed all the A and B alignments.

The most inexpensive location as far as construction costs are concerned was found to be site A (see Table I). Route C was intermediate in cost and approximately 7 percent more costly than A, and 21 percent less costly than D.

The potential traffic was studied by Coverdale & Colpitts, consulting engineers of New York, who found that Route C would be the most attractive to traffic. The A and B routes would be only a little less satisfactory, but Route D would be substantially less desirable. Route D was estimated to attract approximately 16 percent less traffic than Route C.

A study was made of the traffic congestion that may be anticipated in Richmond and San Rafael. There is nothing to choose from among the several sites as far as Richmond is concerned. All the crossings considered will connect with State Route 69 at the western edge of the city and thus provide good service. On the west side of the Bay, Routes A, A-1, B and B-1 all enter San Rafael before connecting with U.S. Route 101, and traffic from any of these crossings would have to make use of city streets. Routes B-2, C, and D connect with U.S. Route 101 south of San Rafael and avoid this difficulty. Since U.S. Route 101 goes through San Rafael on an elevated freeway, there is a real advantage in having the bridge approach join it outside the city limits.

A summary of these factors, which influenced the selection of Route C, is given in Table I. Since service to vehicular traffic, the desires of navigation interests, and congestion in San Rafael particularly combined to favor Route C, it was selected.

A bridge was not the only type of crossing considered for it was recognized that a tube or a fill might have merit. The tube would certainly best serve navigation interests, but it proved substantially more expensive than a bridge and, in fact, could not be financed under a revenue bond issue.

The possibility of a fill was given more consideration than might ordinarily be considered justified because of the long-standing interest in some form of solid barrier to prevent salt water from entering the upper bay. Without regard to whether a barrier would keep salt water out of the upper bay or conserve fresh water, a study and cost estimate were made to see if such a barrier could be combined with a highway crossing. Any such barrier must have a series of navigation locks, and traffic both by water and highway is of such density that no movable highway bridge could be built over the locks. Either a vehicular tube would have to be built under the locks or a high-level bridge over them. To do this and maintain grades not exceeding 3 percent would be expensive. Detailed cost studies disclosed that the cost of providing approaches, increasing the width of the fill to provide adequate roadway widths, and building a bridge over the locks, would approximately equal that of building a separate bridge. There is no economy to be gained in combining a barrier and a highway crossing.

Traffic and Revenue Studied

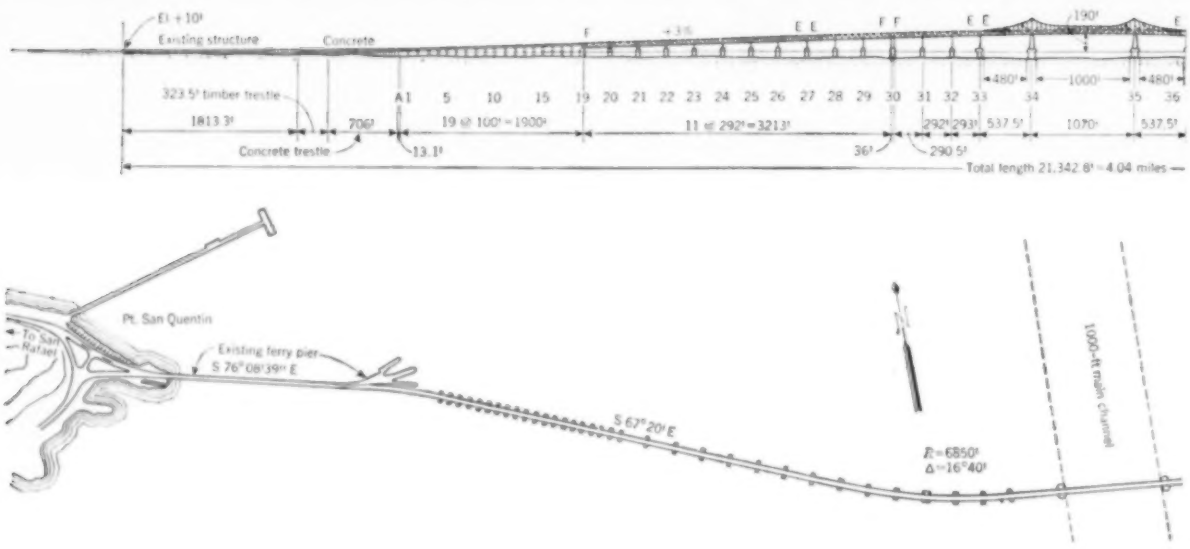
Since the bridge was to be financed by the sale of revenue bonds, it was essential to determine in advance the economic soundness of the project. The revenues were estimated by Coverdale & Colpitts, who conducted origin and destination traffic counts on the Richmond-San Rafael ferry, the Golden Gate Bridge, and the Carquinez Bridge. The study disclosed that 11.7 percent of the traffic now using the Golden Gate Bridge can save time and distance by crossing on the new bridge. Much of this traffic now crosses from Oakland to San Francisco on the San Francisco-Oakland Bay Bridge and thence over the Golden Gate Bridge to Marin County, and would find a route via the new bridge to its advantage. Since the Richmond-San Rafael Bridge will initially, at least, have a higher toll than the Golden Gate Bridge, and since some marginal traffic cannot be expected to use a new route, the actual diversion from the Golden Gate Bridge was estimated at 7.0 percent. For 1951 this would have amounted to 729,000 vehicles.

Similarly it was found that 11.1 percent of the Carquinez Bridge traffic can save time and distance by using the Richmond-San Rafael Bridge. Since the Carquinez Bridge is toll free, not all of this potentially divertible traffic will choose the new route. The amount that can be expected to travel via the Richmond-San Rafael Bridge is estimated at 2.6 percent, which in 1951 would have amounted to 258,000 vehicles.

The planning of financing includes purchase and elimination of the competing ferry. Therefore all traffic now using the ferry will be diverted to

TABLE I. Comparable features of crossings studied

	A	A-1	B	B-1	B-2	C (Chosen)	D
Total length, miles:							
Over-water crossing	2.1	2.2	3.4	2.9	4.0	4.1	3.7
Richmond to U.S. Route 101	10.8	11.4	10.2	10.1	9.1	8.1	10.2
Approaches:							
Maximum grade, percent	5.0	5.0	5.0	5.0	5.0	3.0	6.0
Total curvature, Richmond to U.S. Route 101, deg	1,400	1,495	1,215	1,150	875	545	1,265
Conflicts with industrial development	Yes	Yes	Yes	Yes	Yes	No	No
Uses San Rafael streets	Yes	Yes	Yes	Yes	No	No	No
Relative construction cost	1	2	5	3	6	4	7
Least interference to navigation	3	3	2	3	2	1	2
Best service to vehicular traffic	4	5	3	3	2	1	6



the bridge. In 1951 this amounted to 1,058,000 vehicles.

It is estimated that ordinary traffic growth will amount to 6 percent per year until 1954, and 5 percent per year thereafter until the bridge is completed and opened to traffic.

Universal experience has shown that when the bridge replaces the ferry, the superior facility will induce a substantial increase in traffic. When the Golden Gate Bridge was opened, this inducement amounted to 78 percent. This, and experience elsewhere, justifies the assumption that the Richmond-San Rafael Bridge will enjoy induced traffic amounting to not less than 75 percent of the ferry traffic.

The total traffic over the new bridge for the first year of operation has been estimated by Coverdale & Colpitts to be as given in Table II.

It is assumed that after the bridge is opened, traffic will continue to increase in a normal trend starting at 5 percent per year. It is reasonable to assume that the rate of increase will be less as time goes on.

The present average toll on the ferry is 84 cents per vehicle. The base rate is 70 cents per passenger car and 80 cents for the driver and 4 passengers. In addition there is a transportation tax of 3 percent. The rate proposed for the bridge will average 82 cents per vehicle, and passenger cars will be charged a flat 75 cents. These rates will provide an estimated $3,208,000 of revenue in 1957.

Under existing law the cost of maintenance and operation must be paid for from tolls collected. The estimated annual cost of these items in 1957 is $435,000, and it is anticipated that this will increase to $500,000 by 1976.

Design Features Outlined

The various studies made to obtain the most practical as well as the most economic structure within the construction fund set up by the revenue bond issue of $62,000,000, can be summarized as follows: (1) Duplication of parts and members, (2) simplicity of erection, and (3) ease of maintenance. Although the third item is not necessarily an asset in the construction cost, it is reflected in the overall practicability and efficiency of the bridge.

The over-water crossing consists of the following types of steel spans: Single-deck 100-ft plate girder spans; double-deck 289-ft simple truss spans; double-deck 1,070-ft cantilever truss spans.

The over-water crossing is approximately 4.1 miles in length. Commencing at Point San Quentin in Marin County, the bridge will consist of 2,800 ft of trestle approach connecting to 1,900 ft of 100-ft steel girder spans. The girder spans will be connected to the cantilever structure over the main navigation channel by 4,100 ft of 289-ft truss spans. The span of the cantilever structure will be 1,070 ft center to center of piers, with anchor arms of 537 ft. Between this structure and a similar cantilever span over the secondary navigation channel, there will be 3,000 ft of additional 289-ft truss spans. From this location on to Castro Point in Richmond there will be 3,500 ft of 289-ft truss spans and 1,700 ft of 100-ft girder spans terminating the over-water structure on an earth fill, which will be constructed near Castro Point and on which the toll collection facilities will be placed.

The location and clearances, both horizontal and vertical, of the cantilever spans over the two main navigation channels were fixed by the shipping interests. It then remained to determine the lengths and types of spans to fill in the remaining part of the crossing. The through trusses are designed for two levels of roadway, which necessitated the use of short single-deck runoff spans to bring both roadways to the same level near the shores.

Truss spans of 200, 250, 289, and 320 ft in length were designed and estimated as to cost, as well as typical piers for different depths of water and soil conditions. Probably two span lengths could have been used for the various conditions, the 250- and 289-ft lengths. It was decided, however, that the economies of duplication governed and that only one length of truss span should be used. The 289-ft length was chosen. Except for a few lower chord members, all the 289-ft spans, including those on the horizontal and vertical curves, are duplicates as far as structural elements are concerned.

Only three types of structures were specified in order to obtain the maximum duplication of parts and members. The roadway deck, curbs, and expansion joints on the curved spans have been altered to care for the curvatures. Only one truss needs to be shop assembled for matching connections. The connections of members for all other trusses can be reamed to steel matching templates.

The two cantilever spans are duplicates and can be fabricated as simply as the 289-ft span. The 100-ft runoff or girder spans used to bring both roadways to the same level are also duplicates in so far as possible. These spans are continuous over two piers, and in each alternate span there is a short suspended girder span.

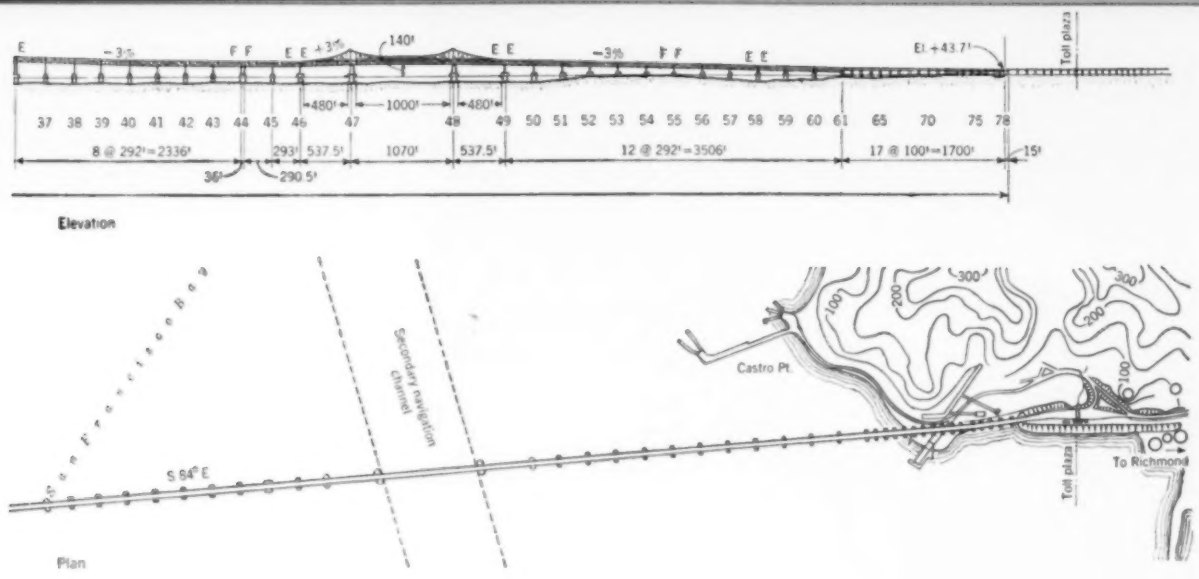


FIG. 3. Profile and plan of Richmond–San Rafael Bridge across north arm of San Francisco Bay show division into two 1,070-ft cantilever spans over main navigation channels, and into 269-ft steel truss spans and 100-ft steel girder spans. Bridge has over-water length of 4.1 miles.

TABLE II. Estimated Richmond–San Rafael Bridge traffic for first year of operation

Source	1951 Traffic	Percentage Diverted	To Bridge, 1951 Level
Golden Gate Bridge	10,384,000	7.0	729,000
Carquinez Bridge	10,100,000	2.6	258,000
Richmond-San Rafael Bridge	1,058,000	100.0	1,058,000
Induced traffic (75 percent of 1,058,000)			794,000
Total			2,839,000
Increase 1952–1957			1,073,000
Total estimated bridge traffic, 1957			3,912,000

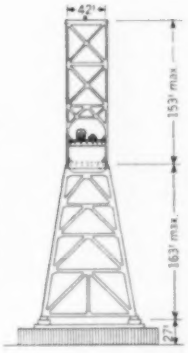


FIG. 4. Cross section through highest cantilever span, which has vertical clearance of 185 ft, shows position of deck to be built now. Lower deck will be added when needed.

Changes in horizontal and vertical alignment at the ends of these suspended girders take care of the curves for the runoff structure.

Various other details in planning were considered to obtain duplication of parts and economies in erecting and maintaining the structure. The steel bents supporting the superstructure were so detailed that the top parts of the columns, as well as the transverse bracing between the tower legs, could be duplicated. On all the truss spans the transverse spacing of stringers is the same. This did not provide the most economical floor system for the longer panels in parts of the cantilever span; however, it provided a satisfactory means of supporting a lighter floor system if it is needed in the future. The 6-in. roadway slab on both decks is of lightweight concrete giving a slab weight of 60 psf, including the weight of reinforcing steel and other details.

The stringers were proportioned by a depth-to-span ratio of $^1/_{20}$ and not by the stress in the member. By replacing the present deck with a lighter floor of not more than 20 psf, an H25-S20 truck loading can be accommodated with little or no alteration to the stringers and still keep the stresses within safe working limits. The floor system in bridges provides the simplest and most practical means of reducing the dead load so as to provide for an increased live loading.

Another matter that had to be considered was the number of panels required for the 289-ft spans. An eight- and a ten-paneled truss were designed; and although the ten-paneled truss required less material, the erection cost more than offset the material cost. Consequently the eight-paneled truss was selected.

The substructure cost depends on many contingent items, such as depth of water, depth to suitable materials for founding piers, depth of overlying materials, currents, and tidal conditions. Knowing first the tentative loads, various pier designs were made and their cost determined for various types of spans. The same procedure was followed for the superstructure. Six different types of piers for the 100-ft girder spans were studied, as well as 13 types for the 289-ft truss spans and 9 types for the cantilever spans.

In general, the cofferdam type of pier construction is the cheapest and most generally used. It was considered in these designs but the length of steel sheeting required was beyond the practical limits, because of the depth of water and of the soft underlying material. Hence cofferdam construction was not suitable.

After studying the various types of pier construction, the patented type of bell-bottom pier was adopted because of its practicability and economy where soft mud extends to considerable depths. This type of pier involves the excavation of a shallow area at the pier location in which a few temporary timber piles are driven and cut off as supports for a timber or concrete mat which is lowered onto them. The mat serves three purposes. It is provided with holes which serve as a template through which the permanent piles are driven. It serves as a

(Continued on page 103)

Highway

LLOYD ALDRICH, M. ASCE

City Engineer, Los Angeles, Calif.

When expansion of an airport usurps the right-of-way of a highway, it has been common practice to relocate the highway. But at the Los Angeles International Airport, Sepulveda Boulevard, the highway involved, is to be maintained in its original alignment, by passing it under the twin runways and two taxiways of the airport, through a subway 1,910 ft long. It is believed that this subway structure, now nearing completion, is the first of its kind in the world to support main airport runways. At the New York International Airport, only taxiways are carried over the Van Wyck Expressway.

Aerial view, looking south, shows construction of subway which carries Sepulveda Boulevard for distance of 1,910 ft under two runways and two taxiways of Los Angeles International Airport. Temporary detour extends to west (right). Project is expected to be completed and in operation by March 1953.

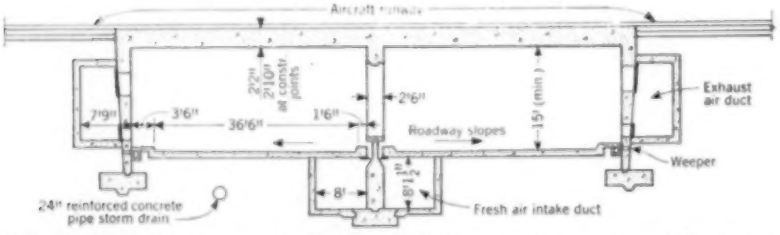


FIG. 1. Subway structure was designed as rigid frame resting on hinged footings at each end, with open column and girder construction for center support. Artificially ventilated structure provides three lanes for traffic in each direction, with turnout bays for disabled vehicles at intervals.

Improvements in the original Los Angeles airport, acquired in 1937, were confined to the area east of Sepulveda Boulevard until 1946, when the commercial airlines started to use the field. The original runways were too short for safe operation and the crash of a passenger plane crystalized the demands for lengthening them. To obtain the additional space needed, Sepulveda and Lincoln Boulevards were temporarily detoured in a "U" to the west, by agreement with the

South portal section of subway has been completed and runways have been replaced over it. South ventilation building is under construction in foreground. Surface drain for airport can be seen at left.

subway constructed under runways of Los Angeles International Airport

Trans-ocean airliner stands on runway over north portal of subway under airfield. Approach paving is in place on divided roadway, which consists of three lanes in each direction.

State Highway Department. The expanded runways were however only temporarily adequate. A rapid increase in the size and landing speed of aircraft soon made further lengthening necessary. The growing importance of the airport and its increasing volume of business also made it evident to the airport authorities that a program of expansion would be necessary to assure the airport's future. The people of Los Angeles voted approval of a bond issue to finance the needed improvements.

West of Sepulveda Boulevard sufficient acreage was available to provide for extension of the runways and the projected future expansion of the airport as a whole. Purchase of this acreage was effected by 1949, and the east-west runways were extended to a total length of 8,500 ft in 1951, leaving space available for future expansion to 10,000 ft. It is notable that at this airport main runways need be provided in only one direction since the prevailing winds are such that 95 per cent of all takeoffs and landings are in an east-west direction.

The second extension of the main runways required lengthening of the detour of Sepulveda and Lincoln Boulevard and its extension westward. Both these boulevards have become major city streets and state highways, and too much traffic uses them to justify permanently detouring them around the enlarged airport. The final solution was to keep the original alignment of Sepulveda Boulevard by building a subway 1,910 ft long, to carry the 6-lane divided roadway under the airport runways and taxiways. The final disposition of traffic on Lincoln Boulevard will be along the future Ocean Parkway on its completion.

Shallow Structure Provided

As for the design of the subway, the proposal to carry two roadways, one in each direction, under the airfield suggested a two-span structure. Economy favored a shallow structure with minimum headroom, and a solid-slab type gave better distribution of the heavy aircraft load concentrations. These requirements could be conveniently met by a reinforced concrete rigid-frame structure, making this type particularly well adapted to the location.

The dimensions of the structure were determined mainly by State Highway requirements. For safety reasons and because it is in reality a city street, a sidewalk was added on the outside of each of the 31.5-ft roadways. Controlling dimensions are given in Fig. 1.

Heavy, concentrated plane loads, when distributed in accordance with engineering practice, resulted in design loadings and structural dimensions for the solid-slab rigid frame not unlike those resulting from H-20 highway loadings. Since the subway will be a part of two state highways, AASHO specifications were adopted

to govern the design when not in conflict with CAA regulations. This federal agency requires all Class 1 airports to provide field facilities to carry loads imposed by a 300,000-lb airplane, 250,000 lb of which is assumed to be distributed to two sets of rear dual wheels in line, and the remaining 50,000 lb to the dual nose wheels.

The subway was designed for a total combined live load of 400,000 lb on four wheels in line, spaced as shown in Fig. 2. The additional 100,000 lb above CAA runway design requirements, for slabs resting directly on the soil, represents the allowance for impact on the structure. For sections of the structure not crossed by runways or taxiways, a live loading from a 15-ton truck plus impact was used as specified by the AASHO, and spread over a lane 20 ft wide, using normal stresses or employing the 400,000-lb plane loading and increasing normal stresses by 50 per cent.

The design stresses used, based on 3,000-psi concrete and structural grade steel were as follows:

$f_c = 1{,}000$ psi, $n = 10$,
$f_s = 18{,}000$ psi

Earth pressures were assumed to produce 36 lb per cu ft equivalent fluid pressure, and included a 2-ft surcharge. Test holes did not show the presence of ground water. However, weep holes were provided to conduct seepage water to the drainage system.

An increase of 25 percent in normal stresses was permitted when stresses due to a 70-deg range in temperature and stresses due to shrinkage were included. Seismic stresses were not considered, experience having shown them to be negligible in rigid-frame structures below ground.

Foundation material at footing elevations is generally a sandy loam with sufficient binder material to compact readily and is stable when wet. Laboratory tests indicated that most of the settlement in the final structure would take place immediately under the dead loads. A safe bearing pressure of 6,000 psf was assumed from the shear-test data.

Rigid Frame Has Hinged Legs

The rigid frame was designed with legs hinged at the top of the footings. A nominal amount of doweling was introduced between legs and footings. Transverse expansion joints, located to divide the subway into longitudinal units 60 ft long, are sealed against water seepage by rubber waterstops.

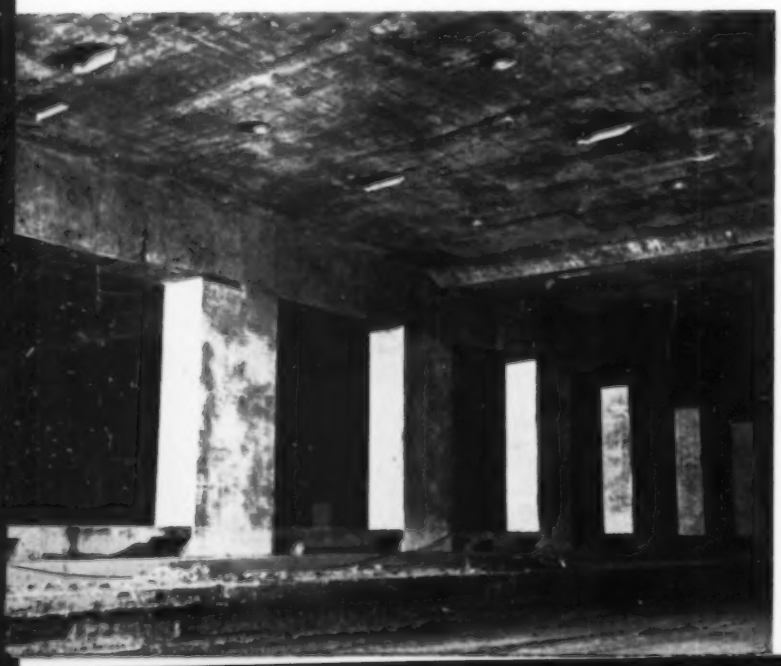
At the deck expansion joints, where load distribution is limited, the deck slab is thickened to 2 ft 10 in. to provide an edge beam 6 ft wide.

FIG. 2. Live load, including impact, used in design was 400,000-lb airplane resting on four wheels in line.

To promote economy in construction, footings are sloped to follow the profile of the airport surface. Frame legs are kept the same height within areas of the same loading conditions. During construction the contractor requested and obtained permission to deepen the edge beams in the lighter sections, and to install a construction joint above the top of the footing, such that forms for the interior surfaces of the subway would be identical throughout its length. This planning enabled him to construct the thirty-two 60-ft sections using only three sets of falsework.

For reasons of economy and safety, open column-and-girder construction was adopted for the intermediate support of the frame. Access from one roadway to the other was thereby provided in case of emergency. To lessen the probability of a traffic tie-up, refuge bays were placed at intervals in the outer walls of each roadway. These bays are formed by increasing each span length the equivalent of one lane of traffic over a longitudinal distance sufficient to accommodate a heavy truck-trailer unit.

Subway lights are recessed into the soffits of the ceiling slab to keep them out of the path of vision. A minimum of 2 to 3 ft-candles throughout the length of the subway is provided by an incandescent lighting circuit in continuous operation. Supplementing this normal lighting circuit for 180 ft at each portal, are banks of fluorescent lighting units graduated from a high entrance illumination of 80 ft-candles to that of the normal circuit. These entrance units are balanced to give a transition from the quality of daylight to that of incandescent light and are intended to provide a period of partial visual adjustment at the portals. Operation of these auxiliary circuits is controlled by clocked switches which can be set manually to switch on and off, thus providing for seasonal or other variations. Interior surfaces of the structure will be painted white to ensure good reflection of light and a feeling of thorough illumination.



Center columns in subway separate roadways in each direction and support rigid-frame construction. Note thickened top slab at expansion joint, ceiling inserts for lighting fixtures, and fresh-air inlets at column bases. Roadway paving has not yet been poured.

Monoxide Analyzer Controls Ventilation

An artificial ventilation system was incorporated in the subway design. The nature of the project and its location is such that few pedestrians will use it, and the time that the motorist will be in it while driving through will be short. Accordingly the design was based on a tolerable dilution to 4 parts of CO in 10,000 parts of air. Since the size of the project does not justify a full-time attendant, the system is to be completely automatic.

The ventilation system, including electrical facilities and the automatic controls, was designed by Ralph E. Phillips, consulting mechanical and electrical engineer. He selected a system of forced air supply and exhaust. Fresh air is to enter at short intervals along the roadways from two parallel ducts located beneath the roadways adjacent to the center piers. At similar intervals foul air will be exhausted into ducts located behind the abutment, as shown in Fig. 1.

Ventilation equipment is to be housed in two reinforced concrete buildings, one at each end of the subway approximately 300 ft from its portals, each to serve half the length of the structure. The building foundations will be separated both from the ventilation ducts, which enter below, and from the foundations for the heavy fans, motors, and hydraulic drives. The tops of the ventilation buildings will be kept below an inclined plane from the runways established by CAA regulations. Each building will house two supply and two exhaust fans.

For automatic operation each building will contain two carbon monoxide analyzers drawing foul air from samplers located in the subway. Supply and exhaust fans will be the centrifugal type, driven by 150-hp, 480-volt, constant-speed, 1,200 rpm squirrel-cage motors, through variable-speed hydraulic couplings. The normal and emergency capacities of each of the four sets of supply and exhaust fans are 187,500 cfm and 225,000 cfm, respectively.

The carbon monoxide analyzers will operate continuous-recording potentiometers, which in turn will control multi-position torque motors regulating the speed control levers of the hydraulic couplings to give the required fan speed. The speed of a supply fan and its accompanying exhaust fan will be varied simultaneously to increase or decrease the ventilation rate for the portion of the subway involved. All fans can be controlled either manually or by time clock. Controls are to be set to start the ventilation system when the CO content ratio reaches 0.5 part per 10,000.

Electrical power for operating and lighting the project will be obtained from an industrial-type substation to be constructed at Imperial Highway and Sepulveda Boulevard, supplied from two power sources with automatic switch gear to maintain power in case of failure from one source. The Los Angeles Department of Water and Power will furnish the electricity at this point at 4,800 volts. Electricity will be carried underground in concrete-encased conduits.

Submersible Pumps Handle Drainage

Surface drainage of the airport will be carried in a northerly direction to a perimeter drain which passes around the airport to the west into a settling area in sand hills. Drainage within the subway will be handled by a storm drain beneath the west roadway. Most drainage flowing into the subway from the approach ramps will be intercepted in three catch-basins located at each portal. Thence a cross drain will carry the water into the main storm drain. Another pair of catch basins located at the midpoint of the subway will collect water which may get past the portal catch-basins and discharge it into the main storm drain. Should water collect at the low point in the fresh-air ducts, an automatically operating pump will discharge it into the storm drain.

The main storm drain under the roadway slopes northerly to an underground reinforced concrete storage box and pumphouse located between the north portal of the subway and the north ventilation building. There two submerged pumps will lift the water from a sump, so that it will

Backfill stomper, constructed by contractor, compacts fill in places inaccessible to sheepsfoot roller. Steel pipe of 20-in. diameter acts as guide inside which 14-ft section of 18-in.-dia concrete-filled pipe, weighing 3,200 lb, is dropped to compact fill. Tests showed that layers of fill 4 ft deep could be compacted to 2 ft, amounting to 95-percent compaction. Note extension of subway slab over turnout bay in foreground.

flow by gravity with the airport's surface drainage previously mentioned.

The pumps, to be furnished by Byron Jackson Co., are to be 1,350 gpm, 40-ft head, submersible nonclog type, with the motor enclosed in an oil-filled watertight jacket under pressure sufficient to prevent leakage of water into the motor housing. Control of the pumps will be accomplished by four electrodes within a transite pipe, so located that when the water level rises sufficiently to contact the lower-starting electrode, one pump will start and continue to operate until the water level is lowered to the position of the stop electrode. If, with one pump operating, the water continues to rise, the second pump will start when the water level reaches the higher starting electrode. Both pumps will then operate until the water level is lowered to the position of the stop electrode.

Two Construction Contracts Awarded

Airport authorities required that one runway be kept open for use at all times during the construction period, and a time limit was placed on the period of interruption. To meet these requirements two contracts were set up. Contract No. 1 was divided into two units, each covering construction of the structural frame and ventilation ducts and restoration of runways and surface contours for half the subway length. Contract No. 2 covered all remaining work, consisting of construction of storm drains, pumphouse, ventilation buildings, extension of ventilation ducts, furnishing and installation of ventilation equipment, all electrical work, grading and paving of the highway and finishing of the subway interior. Construction proceeded without serious difficulties partly because the same general contractor, Oberg Brothers, was low bidder on both contracts.

The contractor elected to use transit-mixed concrete, which attained a design strength of 3,000 psi after 10 to 15 days and 5,000 psi after 28 days. Because of these early strengths, the city permitted the contractor to drive the mixer trucks and the crane handling the pouring bucket, out onto the deck of the last preceding 60-ft unit while pouring the next unit. In this manner construction proceeded, unit by unit.

The city financed all construction work on Sepulveda Boulevard within the airport limits. Funds for this purpose were derived from the bond issue, augmented by federal CAA contributions of approximately 54 percent of the contract costs. The bid of the successful bidder for the first contract was $1,583,478.10. The second contract was awarded to the same contractor for $1,411,889.04. All funds were received and disbursed by the Department of Airports of the City of Los Angeles.

The whole project is expected to be completed by March 1953.

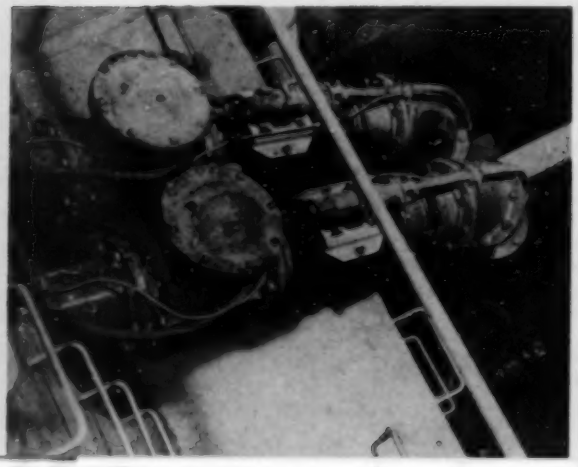
The project was planned and is being constructed under the direction of the Board of Public Works for the Department of Airports of Los Angeles. The plans and specifications were prepared in the Bureau of Engineering under the direction of Lloyd Aldrich, M. ASCE, City Engineer, and Harold O. Springer, at that time Acting Head of the Bridge and Structural Design Division. Construction is being supervised by the Bureau of Contract Administration, with George Peters, Director; L. E. Meidroth, Supervising Engineer; and Vern Ostendorf, Resident Engineer.

For Oberg Brothers, general contractor, Oscar Kringlen is Superintendent.

The department of Airports of Los Angeles is represented by Tommy Tucker, Airport Engineer; and Otis Calhoun, Assistant Airport Engineer. For CAA, A. K. Friedland is District Airport Engineer; and H. L. Henkel, Assistant District Airport Engineer.

First 60-ft section of subway, at north portal, partly aged, supports contractor's crane, which has just lowered motor grader to prepare subgrade for construction of exhaust ventilation duct.

Two drainage pumps are installed in wet well near tunnel portal. In this view top of submersible electric motor projects above water at lower right. Adjustable check valves appear at left, and flexible power cables run along tops of discharge lines. Electronic water-level devices stop and start motors.



San Francisco's Broadway Tunnel completed

RALPH G. WADSWORTH, M. ASCE, City Engineer, San Francisco, Calif.

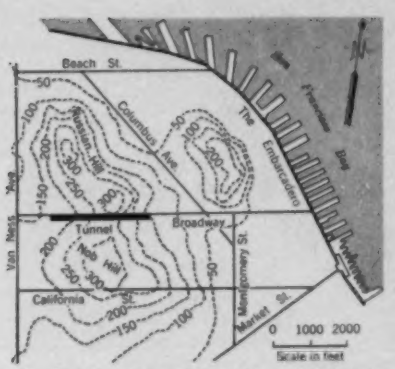


FIG. 1. Broadway Tunnel through Russian Hill provides low-level traffic artery from downtown San Francisco to Golden Gate Bridge.

The twin-bore tunnel recently opened to traffic on Broadway is the latest of many highway tunnels constructed in San Francisco to help overcome the handicap created by a rugged topography. The Broadway tunnel was initiated when the proceeds of a bond issue became available early in 1948. Detailed specifications were completed in 1949. On February 1, 1950, six bids were received and on February 8, a contract was awarded to the low bidder, Morrison-Knudsen Co., Inc., at a total bid price of $5,253,552.35. Work started on May 1, 1953, and all work was completed on January 7, 1953, a total elapsed time of about 2 years and 8 months. The tunnel was opened to traffic on December 21, 1952.

At the present time traffic through the tunnel is about 17,500 vehicles per day. The peak-hour flow in one direction was 1,224 vehicles per hour on January 8 and 1,331 on February 11. These volumes checked very closely with a prediction made in 1945.

Tunnel Location and Plan

The tunnel creates a new low-level traffic artery for motor vehicles between the downtown business district and the northwesterly section of the city including the Golden Gate Bridge. Broadway was chosen as the site of the tunnel because of its 85-ft width, and because it crosses a saddle in the ridge known as Russian Hill, where the minimum length of tunnel could be obtained, as shown in Fig. 1. To take care of long-range mixed traffic, including trucks and buses, and to avoid the delays and hazards caused by occasional disabled cars, the tunnel provides two lanes in each direction.

The general plan for the tunnel and approaches, shown in Fig. 2, was designed to limit the roadway grade to 3 percent, to avoid any appreciable slowing down of heavy vehicles. The position of the roadway grade line was controlled by the level of Hyde and Mason streets, both of which crossed the proposed approach cuts and carried double cable-railway tracks. Grade separations at these crossings were considered essential.

Twin tubes, rather than a single bore, were adopted to reduce cost, to minimize settlement of the overlying ground, to provide greater safety for traffic, and to take advantage of the natural ventilation provided by vehicles traveling in only one direction. The interior cross-sections of the two tunnels are identical. Roadways are 22 ft wide between curbs.

Right-of-way considerations dictated the offsetting of the approach cuts toward the south side of Broadway. Both sides of the street were built up solid, a school and a church being located on the north side.

The effect of offsetting the approaches and portal structures was to place the north tunnel directly under the street area of Broadway and the south tunnel under a continuous row of residential buildings from two to four stories in height. The maximum depth of cover above the tunnels is about 125 ft.

The project length may be broken up into the following significant parts: approach streets channelized, 772 ft; approach cuts, 911 ft; ventilation buildings, 251 ft; and tunnels between buildings, 1,365 ft—a total length of 3,299 ft.

The project required extensive changes in the city's sewer system and high-pressure fire system. The utility companies and the city water department were called on to readjust their pipes, wires and conduits to conform to the new street layout and this work was done at their own expense. Gas and water lines in Hyde and Mason streets were carried across the approach cuts on hangers between the girders of the new bridges. The owners of the cable railways were required to pay for removing their

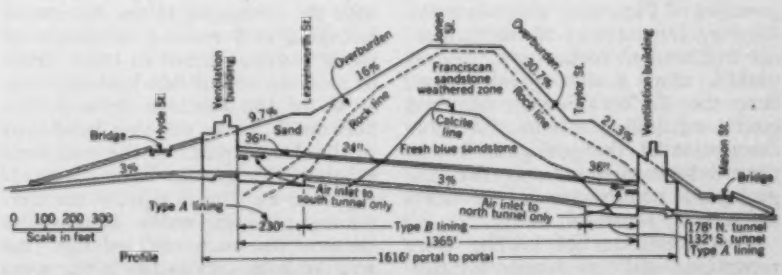


FIG. 2. Soft ground at portals required thick reinforced concrete lining in tunnels as well as heavy retaining walls in approach cuts.

Completed at cost of 7½ million dollars, San Francisco's newest vehicular tunnel was opened to traffic in December 1952.

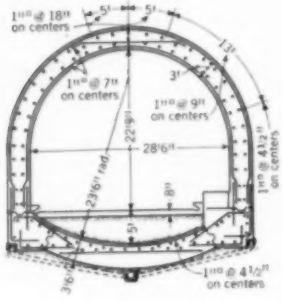


FIG. 3. Footings for Type A lining (used in sand and heterogeneous overburden) were held apart by temporary steel struts until invert concrete was placed, creating complete ring of concrete.

tracks and rebuilding them on the new bridges.

Underground Formations Studied

Hyde Forbes, M. ASCE, engineering geologist, who had been engaged to supervise the diamond drill explorations made in 1944, was retained continuously during the construction period as consultant. His report was used as a basis for estimating probable loads on tunnel lining, and all bidders for the construction contract were invited to examine the report and the drill cores.

The subsurface profile, presented in the report and reproduced here as Fig. 2, showed that three general formations would be encountered: overburden, principally sand at the west end; weathered sandstone; and fresh blue sandstone as distinguished from the weathered material.

So far as the underground work was concerned, observation of the rock in place during tunneling operations confirmed the predictions made in the geological report. However, during early stages of the work the contractor's representatives asserted that the rock pierced by the tunnels differed from what they had been led to expect and from what the Forbes's report showed. In view of the importance of the question so raised, the city sought advice from Dr. John P. Buwalda, consulting geologist of Pasadena, who heads the Geology Department of the California Institute of Technology. He reported, after a field investigation, that the Forbes's report did "not give a misleading and too favorable description of the geological formations to be excavated" and that "the geological conditions in the drifts are actually somewhat better."

Two conditions of loading were recognized and two designs for tunnel lining were adopted. The stronger section, Type A (Fig. 3), was used at each end of both tunnels for the lengths overlain by sand and heterogeneous overburden. Possible arching action in this material was disregarded. The lighter section, Type B (Fig. 5), was designed for use through the rock. In this material it was assumed that arching would occur and that the vertical load on the tunnel lining would not exceed the weight of a 30-ft depth of rock, an assumption confirmed by Karl Terzaghi, Hon. M. ASCE, in the course of an inspection of the tunnels during construction.

High Retaining Walls Redesigned

Retaining walls bordering the approach cuts were designed as conventional T-walls with a loading equivalent to that of a 33-lb fluid. The maximum height occurs where the south wall joins the west ventilation building, the height from top of wall to foundation at this point being 45 ft 6 in.

In the process of excavating for the approaches, bulkheads were constructed by sinking 36-in. I soldier beams in bored holes and inserting horizontal lagging progressively between them as the excavation proceeded downward. Structural steel struts placed horizontally braced the soldier beams from one side of the cut to the other, a total width of about 90 ft. The city cooperated with the contractor in the expense of installing and reading a system of strain gages attached to these struts to measure actual side loading. Analysis of the readings showed that horizontal loads on the bulkheads in the deeper parts of the cuts were substantially greater than the loading used for the design of the permanent retaining walls. It therefore became necessary to redesign the walls of both approaches in the areas between the ventilation buildings and the bridges (Fig. 4).

The very substantial increase in loading on the retaining walls called for thickening of both base and stem. It was also necessary to widen the base, partly to take care of the increased overturning moment and partly to accommodate a lower soil pressure than originally used. Because the contractor's temporary bulkheads had been completed, it was not practical to widen the base by extending the heel or by providing counterforts on the outside. Instead, the toe was extended into the approach cut an unusual amount. As a safeguard against sliding, reinforced concrete struts up to 2 × 2 ft in section were constructed between the toes of the opposite walls on about 16-ft centers through most of the west approach and west of the Mason Street bridge in the east approach.

The two bridges spanning the approach cuts at Hyde Street and Mason Street are of reinforced concrete utilizing continuous girders spanning the cut and supported by a center pier. To carry the cable-car tracks on each bridge, special girders designed with recesses for the cable slots were provided. The roadway slab and the girders were all cast monolithically with the abutment walls.

Tunnel walls and portal facings are completely lined with ceramic tile, using about 1,400,000 separate 4¼-in. tile squares. Pale yellow tiles with semi-matte finish were used for the arch and a darker yellow glazed tile in the wainscot below the springing line. The tiles were normally set with 1/16-in. mortar joints between them and with ¼-in. vertical openings at 44-ft intervals conforming with the expansion joints in the tunnel lining. All tiles were provided with undercut square lugs at the back to insure thorough bond with the plaster coats which were

Excavation for east approach of 1,616-ft twin-bore tunnel shows offset to south (left) to preserve frontage improvements on north side of street.

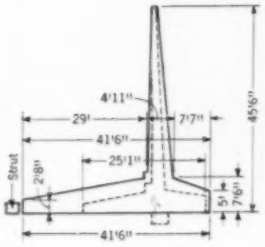


FIG. 4. Unexpected ground loads in approach cuts required heavier retaining-wall section than was originally designed. Concrete struts, 24 in. square on 16-ft centers, between toes of opposite footings, provided safeguard against sliding.

applied to the concrete lining after sandblasting.

The lighting is furnished by a continuous line of fixtures supported by a steel raceway at the crown of the arch and enclosed at the bottom by a plastic cover. In the entrance and middle thirds of each tunnel, the fixtures carry three slim-line fluorescent tubes, while in the exit third they carry only two. Intensities can be varied by controls at the main switchboard. At each entrance a sunlight diffuser, utilizing glass blocks for cover, extends 40 ft out from the face of the ventilation building. This feature, combined with the high-intensity lighting in the tunnel entrance, aids the motorist in adjusting his vision to the inside lighting.

Ventilation is provided in the tunnels by longitudinal distribution in the direction of traffic, with a supply of air from the entrance ends only, in contrast with the more usual method of supplying and exhausting air radially or transversely throughout the length of a tunnel. The system follows the recommendations of Ole Singstad, M. ASCE, based on his experience with numerous vehicular tunnels throughout the country. It is designed to take care of the maximum possible traffic, estimated to be 3,000 vehicles per hour in each tunnel, with 25 percent of the vehicles trucks or buses.

Two blower units are located at each end of the tunnel in the ventilation buildings spanning the roadways. In the east building two 150,000-cfm fans are driven by two-speed 75-hp motors. The two units in the west building have two-speed 15-hp motors and supply 53,000 cfm each. The fans are the backward-curved-blade, silent-vane, slow-speed type with lubricated silent chain drive.

The starting, the two running speeds, and the stopping of the fans are controlled by recording carbon-monoxide analyzers which check continuous air samples drawn through $^{3}/_{4}$-in. pipes from openings in the tunnel walls, opposite the walks, near the midpoint and exit portal of each tunnel. Operation of the fans for each tunnel is automatically started when the carbon monoxide concentration from either sampling point in that tunnel reaches 1 part in 10,000. Both fans operate at high speed when the value reaches 2.5 parts. If the concentration rises to 4 parts in 10,000, the automatic controls change the approach traffic signals to red to stop further entry of cars and also ring alarms in both ventilation buildings.

Elaborate facilities have been provided to minimize the hazards caused by collisions and fires or the failure of the ventilation systems.

Tunnels Excavated from Two Drifts

Since the character of the ground in the east approach cut convinced the contractor that full-face tunneling would be impractical, five separate drifts were started in the north tunnel: one at the crown, one for each wall plate, and one for each wall footing. Ribs were set by winging out from the crown to the side drifts. After proceeding about 150 ft, the contractor decided to modify the steel ribs by cutting and welding so as to place the wall-plate joint at the springing line. The driving of the upper three drifts was discontinued at about the same time.

The two drifts driven thereafter were located at each side of the base of the tunnel section so as to include the space required for the permanent concrete wall footing and the vertical sidewall, as shown in Fig. 5. To support the ground in each drift, square sets were used consisting of a 12 × 12-in. cap which rested on a wood post on the side toward the center of the tunnel, and on the steel wall-plate and steel-rib plumb-post on the outside. To permit the use of the wall plates in this manner, they were made up in 6-ft lengths with bolted connections. Sufficient horizontal clearance was provided between posts to permit the use of a Conway mucking machine. The drifts proceeded at a rate of about 275 ft per month. Driving was principally from east to west.

The partition of undisturbed ground remaining between the two drifts was about 10 ft wide. In that part of the tunnels designed for Type B lining, only about 60 percent of the excavation remained to be done after the two drifts were completed.

Following the excavation of each drift, the longitudinal side drain and the cross drains for the width of the drift were installed, and the concrete footing and about 3 ft of sidewall were poured, concrete being pumped in from the portals. The steel plumb-posts were encased in this concrete, which gave them rigid support for about half their height.

The remainder of the tunnel excavation was performed in one operation with the help of a specially built jumbo called a "breast-board machine" which proceeded westward, first through the north tunnel and then through the south tunnel. This jumbo consisted of a structural steel frame about 53 ft long, 25 ft wide and 23 ft high, and weighed about 50 tons. It was carried on four 2-wheel trucks which ran on a track of 20-ft gage and was held in place or moved forward by four hydraulic rams acting against the completed steel ribs to the rear. The machine served three purposes. It supported the face of the excavation above the drifts by means of 18 small breast-boards actuated by hydraulic pistons; it provided a working platform for the miners while drilling, spading and

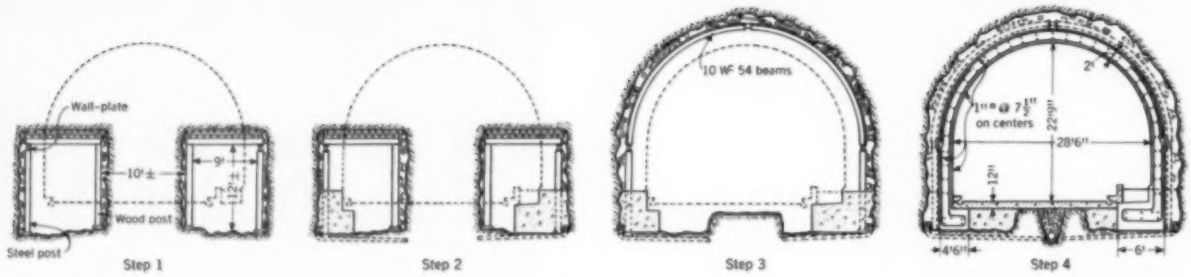


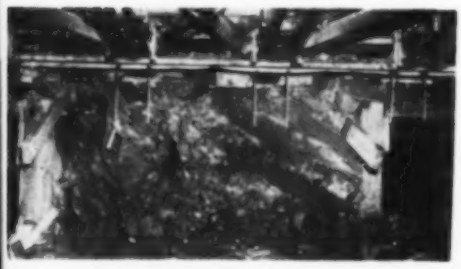
FIG. 5. Type B tunnel section was used in rock. Tunneling procedure was as follows: Step 1, drive two drifts at wall-footing lines and support ground: Step 2, place wall-footing concrete; Step 3, remove arch and core using 50-ton breast-board machine, set steel ribs on about 3-ft centers, and pack with wood blocking; Step 4, set collapsible steel forms and reinforcing steel from special jumbo, then pump in concrete to complete walls and arch. Finally, complete floor drain and place reinforced concrete floor.

Each two-lane bore is ventilated by blowers at entrance end only, to hold carbon monoxide concentration below 2.5 parts in 10,000. Lining is of yellow ceramic tile.

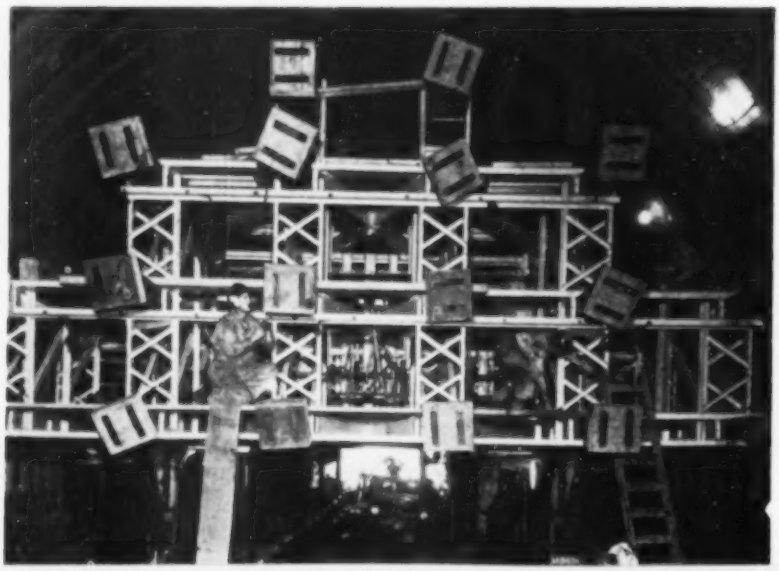
lagging; and it lifted, moved forward and set in place the steel ribs forming the arch, by means of hoists, sliding carriers and rollers. Working under the machine, a rocker shovel loaded the muck into trucks. The excavation proceeded at rates between 300 and 440 ft per month with three shifts working six days a week.

Powder was used regularly in the excavation of drifts and core but in widely varying amounts, the purpose being usually to loosen up the material rather than remove it. No definite pattern of drilling or loading was established. Holes were loaded with from $\frac{1}{2}$ to 2 sticks of 45 percent powder, and a few rounds contained as many as 100 sticks. Powder consumed on the whole job was equivalent to about 0.262 lb per cu yd of material excavated. Corresponding figures for the drifts (Type B tunnel) and for core removal are 0.712 lb and 0.124 lb respectively. The powder used in the Type A tunnel drifts through the overburden near the portals was negligible.

Arch ribs were generally set 3 or 3.5 ft center to center, but were considerably closer during the early stage of the work in the north tunnel, where for a short stretch they were set 1 ft center to center. Since they rested on the wall plate, the spacing could be varied without regard to the position of the plumb-posts below. Wood was used for blocking, and sufficient lagging and packing were placed to prevent in-



Excavation was started by driving two 12 × 14-ft drifts, one at each lower corner of tunnel section. See Fig. 5 and photo of typical drift (below, right), in which steel posts, later to be incorporated in tunnel lining, appear at right. From these drifts about 40 percent of yardage was shot and excavated by Conway mucker. Remainder of 32 × 26-ft horseshoe section was removed in one operation using 50-ton breast-board machine, forward face of which is seen below, left. Face of core under this machine, with drifts on each side, is seen at left. Muck was removed into trucks by rocker shovel operating under breast-board machine.



Project Costs. Final costs to the city for all items of the project were as follows:

Construction	
Tunnel construction:	
Type A tunnel, 771.2 ft	$1,265,047
Type B tunnel, 1,958.3 ft	1,717,049
Extra concrete and steel	62,484
Grouting, 14,500 sacks of cement	56,685
Subtotal, tunnel construction	$3,101,265
Tile walls and arch, 19,847 sq yd	329,675
Lighting system in tunnel	104,250
Water and fire hydrant system	28,151
East ventilation building	629,147
West ventilation building	367,309
Mechanical work	134,436
Electrical work, including signals and exterior lighting	167,636
Approach cuts and walls	689,965
Bridges	195,735
Paving approaches and adjoining streets	153,154
Modification of sewer system	148,635
Modification of high-pressure fire system	53,406
Miscellaneous	35,789
Total construction	$6,138,553
Right-of-way	
Land purchases less salvage	800,410
Adjustments to new street grade	101,000
Subsurface easements	9,975
Total right-of-way	$ 911,385
Engineering	
Preliminary studies, surveys and borings	24,625
Plans and specifications	141,740
Surveys and supervision of construction	306,319
Total engineering	$ 472,684
Grand total, project cost	$7,522,622

jury to workmen by falling rocks. Much of this wood was removed before the concrete lining was placed.

Placement of reinforcing steel and concrete lining above the previously poured footings followed closely behind the core removal. Four collapsible steel forms 22 ft long were used, bolted together in pairs except on curves. They were moved forward alternately by means of a jumbo running on the same track as the breast-board machine. Concrete was brought in by ready-mix trucks and pumped back into the forms by two concrete guns through pipes entering the forward bulkhead about 8 ft each side of the crown. Vibrators were operated by workers standing inside the form. The pipes were gradually withdrawn as the form was filled from back to front and finally replaced by two pipes inserted 6 ft apart at the crown. An air-entraining admixture was used in the concrete. Tests of cylinders showed that a concrete strength of 1,000 lb per sq in. was obtained in about 36 hours. Forms were stripped about 40 hours after pouring, which made it possible to cast three 44-ft sections per week.

The invert called for by the Type A design was placed some time after completion of the walls and arch. Before it was placed, the center drain was installed by trenching without lagging. To prevent inward movement of the footings during excavation for the drain, and subsequently for the invert, structural steel struts were placed across the trench between footings. These were salvaged before the backfill was placed on the invert.

Ground Movements Measured

Before any construction work was started on the tunnels, city survey parties took accurate elevations on one or more identifiable points on every building and on street monuments and manhole castings along Broadway and also along the adjoining parallel streets. The city cooperated with the contractor and his insurance carrier in making a thorough inspection of the physical condition of all buildings fronting on the streets covered by the instrumental survey. All structural defects were recorded by means of notes or sketches and many photographs were taken. The inspection in most cases included interiors, made with the consent of the owner and, whenever possible, in his presence. A record sheet for each piece of property was signed by representatives of the city and the contractor, and in some cases by the property owner. Owners were fully informed as to the purpose of the survey and were assured that it would help to avoid arguments and delays in the settlement of valid claims for compensation in case any damage should occur.

The area of greatest ground movement occurred near the east portal between Taylor Street and the ventilation building, where the tunnel overburden proved to be largely a loosely consolidated man-made fill. Three buildings on the east side of Taylor Street south of Broadway had to be supported by the contractor on cribbing and jacks throughout the tunnel construction period. Some of the footings settled as much as a foot and there was a lateral movement of about 2 in. toward Broadway.

Inspections disclosed little movement of temporary supports in the drifts although a few of the wood posts supporting the partition between adjoining drifts showed evidence of bending. The only movement of concrete footings of any consequence was at the south side of the north tunnel below the city block running from Jones Street to Leavenworth Street. Under the easterly half of this block, the footing settled from $^3/_4$ to 1 in. The settlement was accompanied by a horizontal inward movement of $1^1/_2$ to 2 in. The cracks in the footing did not reopen after being sealed, and the necessary adjustments of roadway line and grade were made without complications.

The design of the tunnel conformed closely with the general plan prepared by the consulting engineer, Ole Singstad. All detailed design work was done by structural, highway, mechanical, electrical and traffic engineers in the Bureau of Engineering of the Department of Public Works under the general direction of the writer as City Engineer and R. H. Owens, A. M. ASCE, Senior Engineer in charge of the Design Division. Roy C. Hackley, M. ASCE, consulting engineer, advised the staff on tunnel methods and practices before and during construction. Assistant City Architect John H. Devitt supervised building plans and exterior treatment. H. C. Vensano, M. ASCE, as Director of Public Works, took an active interest in the design work. Sherman P. Duckel, A. M. ASCE, was Director of Public Works and contracting officer during the construction period. The City Engineer's representative on the job was George J. Partridge, Resident Engineer. The Morrison-Knudsen Co., Inc., had three successive superintendents on the job, T. Y. Johnston, Louis L. Wheeler and John F. Erdle, A. M. ASCE.

(This article is taken from the paper (Convention Preprint 80) presented by Mr. Wadsworth before a Highway Division session, presided over by Ralph A. Moyer, chairman of the San Francisco Section's Highways Committee, at the San Francisco Convention of ASCE.)

FIELD HINTS

Gunite blanket improves foundation grouting for earth dams

JAMES B. HAYS, M. ASCE

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Under earth, gravel, or rock-fill dams, difficulty is often experienced in completely filling all seams with grout where the impervious core makes contact with the rock surface. The primary object is to force the grout to take a long leakage path when it is being forced in under pressure in the upper zone. If a simple grout hole is used, as shown at the left in Fig. 1, there is often considerable leakage, even at low pressures, and within a few feet of the hole. Before this surface leakage can be sealed off by wedges or calking, the finer cracks further down are sealed off by cement that has adhered to the sides of the hole. The result is an incomplete job unless a number of holes are drilled and grouted in the immediate vicinity.

By coating the rock surface with a gunite blanket or similar covering, as shown at the right in Fig. 1, it has been found possible to get a wide spread of grout in the upper several feet of the rock, which is usually more open than the deeper rock. Higher pressures can be used at the outset, and the results are better than those obtained with a large number of consolidation holes, as actual experience has shown.

Other advantages of the gunite blanket are: A longer leakage path for water is created at the core contact, since the water cannot travel through the rock to get to the clay. Therefore no core wall is needed. Better tamping conditions are secured at the edges of the impervious core as irregular pockets that cannot be reached by the standard hand or air tampers are filled in. The gunite produces a rough sandpaper surface for bonding with the impervious core that is often much superior to the natural rock surface.

Of course, this method is not always necessary. For instance, on the Kajakai Dam in Afghanistan, a rock-fill structure over 300 ft high, the rock was a massive limestone, with bedding planes nearly horizontal and bedding seams nearly 100 percent tight. However, there was a rather definite pattern of vertical cracks. The solution was to gunite the cracks after they had been cleaned out as much as possible. Grout holes were drilled in the line of the main cutoff to intersect the joints

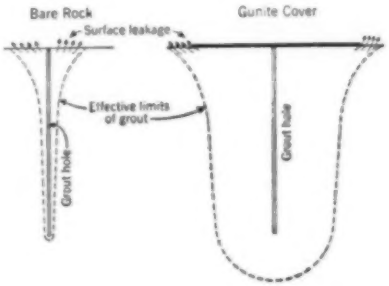


FIG. 1. Effectiveness of grouting seamy rock through gunite blanket (right) is shown. By forcing grout to travel some distance in upper and more open zone, higher pressure can be maintained throughout full depth of hole, and more effective sealing is obtained with fewer holes.

Construction view of Kenney Dam shows grouted core trench in background with gunite blanket in place. In foreground heavy equipment places material for sloping impervious core. Rock fill, which forms main part of dam, is seen at left.

Some of better rock in core trench for Kenney Dam is seen above gunited area in right foreground. Man farthest from camera is applying gunite blanket with spray gun while man in front of him cleans up rebound.

at various depths. Pipe relief vents, installed at frequent intervals, frequently came into play during grouting; they were plugged after all water and thin grout had escaped.

In the case of the 325-ft Kenney Dam on the Nechako River in north central British Columbia, the gunite blanket proved highly effective. This is a rock-fill dam with an inclined impervious core together with the usual filters. (See "Alcan-British Columbia Power Project Under Construction," by W. G. Huber, CIVIL ENGINEERING, November 1952.) The rock foundation is basalt with beds of vesicular rock, the whole mass overlying a volcanic breccia. There were seams, cracks and joints in every direction, with hardly a square foot of solid rock in sight anywhere. In this case the entire area of contact of the impervious core with the rock was gunited before grouting.

The thickness of the gunite varied considerably, but the minimum was about $\frac{1}{2}$ in. The maximum thickness of 6 to 8 in. was used in filling deep pockets in the surface where pieces of rock had worked loose. No reinforcing was used under ordinary conditions.

There was remarkably little cracking of the gunite. Several thousand square yards were applied during the winter of 1951–1952, when the temperature frequently got down to 20 deg below zero. The area was first rough cleaned and then housed in. Salamanders and blower heaters, used to warm up the rock and thaw out the seams, loosened more rock. A few grout holes were drilled to get rock temperatures.

Before long the mass was warmed up to about 40 deg above zero and the gunite was applied. After a period varying from four days to a week, the curing temperature was allowed to drop gradually, except for a 20-ft strip in the center of the zone, or 10 ft on each side of the grout curtain, until grouting was complete in the area. Grout was kept at 50 deg F.

No difference in the amount of cracking was noted between gunite placed in winter and that placed in summer. Some cracks were caused by grouting. Pressures of from 50 to 100 lb were used on holes 30 ft deep. Some leaks were forced through what were probably weak spots in the gunite. In numerous cases grout leakage was forced clear to the edge of the gunite and in some cases beyond.

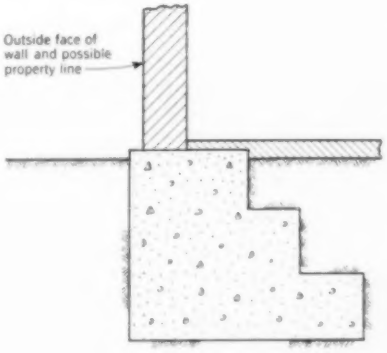
Vents were spotted before guniting, and in probably 50 percent of the cases were effective. Any vents that did not leak were filled with a thick grout mix when grouting in the area was completed. The treatment was considered well worthwhile and the results very satisfactory.

Design and engineering supervision of the dam were carried out by the British Columbia International Engineering Co., Ltd., Vancouver, B.C., and the International Engineering Co., Inc., San Francisco, Calif., with C. P. Dunn, M. ASCE, president, and D. J. Bleifuss, A.M. ASCE, chief engineer and vice president. The latter was made responsible for the overall construction of the dam. The writer had charge of the dam construction and developed the foundation treatment method here described. The dam was completed, with the last grouting of the tunnel plug, about December 8, 1952.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

A question had arisen regarding the safe floor load for a rather old three-story isolated brick building, of timber interior, located in a suburb of a large city. The building was well preserved with columns and joists exposed for easy measurement. The initial question related to the adequacy of the wall connections and interior construction. No question had been raised regarding the foundation since the loads were relatively light. In sketching a cross section of the structure to accompany the report to the city building department the draftsman included, for full measure no doubt, a guessed-in footing beneath the exterior brick walls. See Fig. 1. Why did the building commissioner require a supplementary report on the wall foundations? They were not visible and, since the building was built prior to the days when plans were required to be placed on file, considerable excavation was required to secure the additional information. For solution, see page 86.



EDITOR'S NOTE: This is the thirteenth installment of a series which started in the February 1952 CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

ENGINEERS' NOTEBOOK

Hydrostatic pressures under a canal measured accurately

P. H. S. FOLLETT, J. M. ASCE
Structural Engineer, Bedell & Nelson, Engineers, New Orleans, La.

Perforated pipe is set in place before canal bottom is poured.

To improve drainage conditions in a highly built-up section of New Orleans, La., the city's Sewerage and Water Board recently replaced an open wood-lined canal that had been in service since 1906 with a covered reinforced concrete conduit designed to carry 2,800 cfs. Because of the limited funds available and the wide span of the canal, it was necessary to depart from the usual box-type section and develop an entirely new and more economical design.

The barrel of the canal was designed as a rigid frame with thin tapered members, hinged at its connection with the bottom, as shown in Fig. 1. The bottom served as a tie between the hinges and as a channel for dry-weather flow. The frame and bottom were investigated for all expected combinations of loading, but because of the unknown variations in pressure acting on the bottom during rainy periods, broad and conservative loading assumptions were made.

To ascertain the true pressures acting on the canal bottom, A. Baldwin Wood, superintendent of the Sewerage and Water Board, authorized the installation of perforated pipes at several locations in the bottom of the canal during construction. These pipes projected approximately 2 ft below the canal and were sealed inside the canal with a blind flange. A shell fill was placed around the pipe to keep the $^1/_4$-in. perforations from being clogged with earth. When the canal was completed, two Foxboro liquid level gages were installed on top of it, one to register the pressures under the canal bottom and the other to register the water level inside the canal at the same location.

Machine foundation supported by steel rods driven through clay

ERNEST E. HOWARD, Past-President ASCE, Howard, Needles, Tammen & Bergendoff, Consulting Engineers, Kansas City, Mo.

One of the most interesting examples of foundation design and construction I learned of on my journey last autumn to attend the Congress of the International Association for Bridge and Structural Engineering in London and Cambridge, was a foundation support for a paper-making machine designed and built by Haakon Eeg-Henricksen of Oslo, Norway. Mr. Eeg-Henricksen is at present giving all his attention to public service for his country, serving as Director General for Defense Construction. As engineer and builder he has been responsible for many important works in Norway, representing many original ideas both in design and methods of construction.

In describing the concept of this particular foundation, he asked me, "Have you ever used a cork to drive a needle through a coin?"

"Yes," I said, "that was a boyhood diversion. You push a needle through a cork; break it off so it is just the length of the cork; set it on a penny, hit it with a hammer, and the needle penetrates the coin."

"Just so," he replied, "and without the cork the needle would bend or shatter. The soft cork provides all needed lateral support. Upon that principle I designed this foundation underpinning."

The details of the project as then outlined and later supplemented by Dr. H. C. Borchgrevink, who is now associated with Mr. Eeg-Henricksen in defense work, are briefly as follows. The paper-making machine is 141 ft long and weighs 670 tons. Its concrete base had been set on a bed of clay, which is continuous down to rock 130 to 165 ft below. When the machine was running, the whole thing, including the foundation, moved up and down in waves, and one side

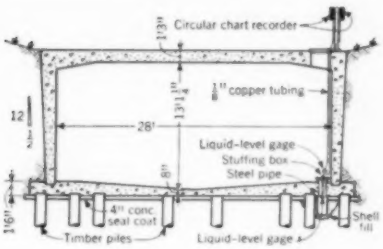


FIG. 1. Continuous recorders measure uplift under New Orleans drainage canal.

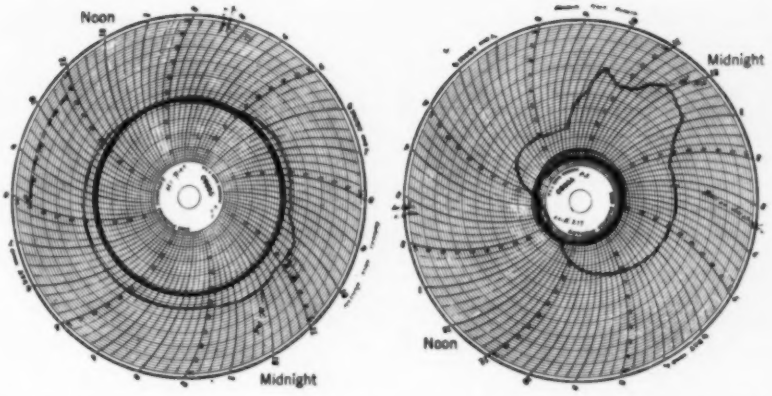


FIG. 2. Chart at left shows water level inside canal during a rain storm. Chart at right shows amount and variations in uplift under canal bottom at same location.

On clock-driven circular charts, the gages recorded the pressure variations both inside the canal and under the canal bottom over a 24-hour period.

Because the canal was subject to strong uplift during dry periods, a means was devised for attaching the bottom gage to the perforated pipe so that this uplift pressure would register on the charts as soon as the gage was bolted in place. This was accomplished by passing the $^1/_8$-in. copper tube, leading from the gage to the recorder, through a stuffing box mounted in a circular plate that could be bolted to the perforated pipe flange (Fig. 1). The stuffing box prevented leakage around the tubing where it passed through the plate. At the stuffing box the $^1/_8$-in. tubing was strengthened by slipping a short piece of $^3/_8$-in. brass tubing over it and filling the annular space with solder.

During an eight-month test period, a large number of circular chart readings were secured. These charts, of which Fig. 2 shows samples, furnish a clear picture of the pressure conditions under the canal at the test location. Readings showed that tidal variations from nearby Lake Pontchartrain and stage variations in the Mississippi have no effect on the uplift pressure acting under the canal; that during periods of dry weather, there is an uplift of approximately 9 ft of water, caused by the high elevation of the subsurface drainage coming into the canal; and that during rainy periods, the inside pressure from water in the canal is approximately equalled by the outside uplift from ground water.

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wall of the foundation in longer waves than the other.

Mr. Eeg-Henricksen's remedy for this precarious situation was to carry the load of the machine and its foundation to rock on slender steel rods. Reinforcing rods $1^1/_4$ in. in diameter, of ordinary quality, were used, welded together in 20-ft lengths. They were loaded to 13,600 psi. On top, a steel plate was used to distribute the load. Altogether, 84 rods were driven.

The rods were forced down by pressure using a simple hand-operated jacking mechanism. A small clamping device seized the rod for the down stroke of the lever, and released it for the up stroke. The weight of the machine and foundation supplied the needed counterbalance for jacking.

Resistance increased with depth. Below 100 ft it was found necessary to use an ordinary compressed-air rock drill on top of the rod, putting it into vibration. The longest rod pushed down in this way was 161 ft; the shortest, 136 ft. The greatest resistance during jacking down, without vibrating the rod, was measured to be 5 tons, which corresponded to a bond stress of $1^1/_2$ psi of the rod's contact surface. One rod 145 ft long was pushed down to rock in about 3 hours.

This underpinning was carried out without interrupting the mill's ordinary operation. The work was done at night and the equipment removed in the daytime so as not to interfere with paper production. The free height under the mill roof was limited to 20 ft.

It is Dr. Borchgrevink's opinion that the method is applicable in pure clay only. He said the clay in Norway usually is pure, containing no boulders or gravel. It was formed by sedimentation under water during a preglacial period. However, he added that the method is so inexpensive it does not matter if a few rods must be rejected and additional ones jacked down.

He stated also that a Swedish civil engineer, John Olsson, proved by tests in 1926 that a steel rod of circular cross section driven into clay has a resistance of more than 100 times its theoretical buckling resistance. About ten years later another Swedish civil engineer, Mr. Fellenius, carried out several tests in the harbor of Gothenburg, where he pushed down steel pipes 2 and 3 in. in diameter to rock approximately 130 ft below the surface.

Tests showed that the pipes could be loaded to the yield point of the steel. So far as is known the first practical application of these Swedish tests was that by Mr. Eeg-Henricksen about two years ago, as described above. An account of this project was published in 1951 in the Norwegian technical journal, *Teknisk Ukeblad*.

The ingenuity of the design and execution is noteworthy. The satisfactory load-carrying capacity, averaging nearly 8 tons each for the $1^1/_4$-in.-dia rods 140 ft and more long, will increase confidence in the load-carrying capacity of steel piles point-bearing on rock.

THE READERS WRITE

Solutions Proposed for Problem of Controlling Sand Erosion Along Pan American Highway

Wooden Shed Proposed

To the Editor: Referring to the problem "How Would You Do It?" in the January issue, p. 63, and to its proposed solution, p. 71, it is felt that the cost of this construction, which involves a wide cut into the mountain side, and elaborate excavation and fill to install the sand drains, would be very high.

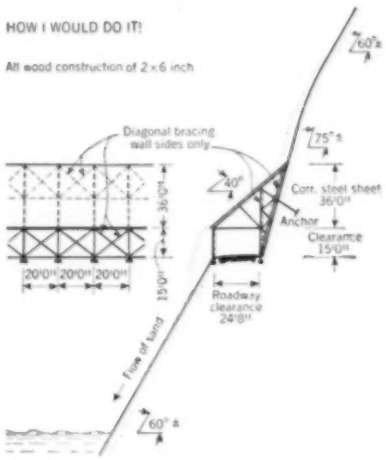
In the enclosed solution sand is disposed of overhead.

The cost of this construction is 0.7 against 1.00 for the solution given in the January issue. The disadvantage of lack of all rain on the roadway as a result of the shed can be eliminated by interrupting the shed at places where the flow of sand is a minimum.

It may be of interest to point out that this solution is often applied for the protection of mountain roads against sliding snow in Alpine areas of Europe.

E. E. Verbeemen
General Management
Construction Engineer
Headquarters USAREUR
Engineering Division

New York City, N.Y.



Wooden shed arrangement is proposed to solve problem of keeping sand from Pan American Highway along Pacific shore in Peru. Highway runs about 100 ft above ocean and 500 or 600 ft below crest of hills or dunes. Sand rolling down slope would block highway in 12 hours in some places, and contractor has full-time contract to keep roadway clear.

Asphalt Suggested

To the Editor: From the problem of sand spillage on the Pan American Highway in Peru, as given in the January issue (p. 63), it would appear that the basis of the trouble is either wind erosion, loosening of loosely cemented sand particles through temperature changes, or a combination of these factors. Moisture change evidently plays a minor role. At any rate if the erosion could be reduced, the maintenance effort would of course decrease.

Would it not be possible to use some cementing material, such as a light grade of cutback asphalt, to penetrate the surface of the sand slope very much as we use liquid bituminous materials to prime soil-type courses in road construction? A shot of 0.30–0.35 gal of MC 1 would give a protective coating of sand asphalt matrix varying in depth from $\frac{1}{2}$ to 1 in., depending on the sand characteristics, which would resist further erosion. Special equipment operated from the top of the slope, using a spray bar and flexible hose suspended on cables, would have to be developed for the application but this should not overtax our ingenuity.

The amount of material and equipment does not seem too costly in view of the savings in maintenance and traffic safety involved. For a slope on a 60-deg angle and 600 ft from base to summit, the area exposed would approximate 410,000 sq yd per mile of roadway. Using $\frac{1}{2}$ gal of cutback asphalt per sq yd of surface would require about 140,000 gal per mile. Equipment costs, including development, would be rather high in Peru but it is difficult to see how the overall unit price per gallon of application should go to more than about $0.50.

K. F. Shippey

Atlanta, Ga.

Performance of Hydraulic Dredges Reviewed

To the Editor: With reference to the three very interesting articles on subaqueous excavation in your September or Centennial issue, by H. H. Everist, Jr., Carl H. Giroux, C. M. Romanowitz, and Herbert A. Sawin (pp. 75, 156, and 162), a little history and additional data may be of interest.

Back in 1855 two Germans, Schwartcopff and Hoffman, built the first hydraulic dredge. It had a centrifugal pump driven by a steam engine. The material was loosened by a pick-type cutter, and ox-hide connections were used for flexibility on the discharge line. Compare this with the dredging plant described by Everist and Giroux.

In 1855 an American, Nathaniel H. Libby, built the first hopper dredge. It was used on the Charleston, S.C., bar and had a reported hopper capacity of 200 cu yd. This dredge deepened the entrance to Charleston harbor when other equipment had failed. Compare the capacity of this dredge with the 8,000-cu yd capacity of the *Essayons* as described by Mr. Giroux. This shows the advance in hydraulic dredging in approximately one hundred years.

In connection with the 36-in. discharge dredge mentioned by Mr. Giroux, being built by Marine Industries of Montreal, it is understood that this dredge is to be used on comparatively short pipelines; therefore its 8,000 hp will probably be adequate on the pump. However, 1,000 hp on a cutter seems below normal requirements considering the material it has to excavate. It would be interesting to have the designers, Ellicott Machine Corp., comment on this.

Some recently built dredges in 20 to 30-in. sizes, with from 2,000 to 6,000 hp on the pump, have from 600 to 2,000 hp available for the cutter. The Western Contracting Corp.'s 30-in. dredge *Western Chief* for instance, has available 1,500 hp on the cutter, with considerable overload capacity, and has used it all in excavating rock at Fort Randall Dam, Pickstown, S.Dak.

As to performance, there are several 27 to 30-in. hydraulic dredges that have done over 100,000 cu yd daily in silty materials. A discharge pressure of 150 lb and higher with one pump is common. The U.S. Bureau of Reclamation's 20-in. dredge *Colorado* has been pumping about 1,000,000 cu yd monthly for years on the Colorado River below Davis Dam, and the *Western Chief* closed the Missouri River at Fort Randall in short order by pumping a rock fill across it, as described in the September issue and also in the August 14, 1952, *Engineering News-Record*. Rock excavation with hydraulic dredges is now considered standard practice except in hard rock, where blasting is still required. Of course the dredge and its component parts, particularly the cutter and ladder, must be designed for this type of excavation.

Mr. Giroux mentions small portable dredges. I believe that these can be built in practically any size almost as cheaply as

(*Continued on page 100*)

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2 No. 1055 P & H 3 cu. yd. Shovels with Buda Diesel Engines, 1948
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Robins H D Scalper with LeRoi Gasoline Engine, 1950

TRACTORS and DOZERS

2 Allis Chalmers Model 8D19H with Bulldozers and Le Tourneau Power Control Units, 1948
3 International Model TD24 Tractors, 1951
15 Caterpillar Model D8, Series 2V and 8R Tractor Dozers with Power Control Units.

GRADERS

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2 Caterpillar No. 12 Diesel Powered with Scarifier Attachment, 1946

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SOCIETY NEWS

Dr. Robert Gordon Sproul (left, in top photo) attends Wednesday Membership Luncheon, at which he was principal speaker. Shown with him are presiding official A M Rawn, Vice-President of ASCE, and President Walter L. Huber. Prominent on technical program were D. J. Bleifuss (left in center view) director of engineering for the International Engineering Co., and Ralph A. Tudor (center), new Under Secretary of the Interior. They are seen chatting with J. G. Wright, president of San Francisco Section. In lower photo, President Huber presents Daniel W. Mead Student Prize for 1952 to Charles E. Negus, Jr., J.M. ASCE, of Auburn, Calif. With them is ASCE Director James A. Higgs.

San Francisco Convention Speakers See Big Work Ahead for Civil Engineers

Optimism was the keynote of the San Francisco Convention of ASCE, held March 3 to 6 in the "City by the Golden Gate" with the Society's oldest Section as host. It was implicit in President Huber's remarks of welcome to the Convention and to his home city; it was explicit in predictions voiced in a panel discussion on the effect on the construction industry of a possible reduction in defense spending. It was in the tonic air of San Francisco, with its tremendous engineering and construction activity, its famous restaurants and hotels and shops; it was in the enthusiasm of the 1,350 engineer visitors and their families for sightseeing and for everything else that came up in the four-day program.

President Huber Addresses Opening Session

In the major address at the Wednesday morning session, President Huber reviewed the past century of civil engineering in California, with particular stress on the achievements of the pioneer experts in the field and the accomplishments of ASCE members in the development of the state. Confronted with arid summers and major need of water in mining operations, the engineers of a century ago devised a system of canals which to this day are regarded as "feats to excite admiration," said Mr. Huber. He added that "the engineers who planned and built them were often pioneering beyond precedent." In their management of hydraulic mining problems, too, "The early California engineers were unexcelled anywhere, and their services were widely sought in South Africa, South America, Australia, Canada, Siberia, and elsewhere."

Mr. Huber promised that though it is "beyond the power of any man now living to visualize the enormity of developments affecting the next century, it is certain that the engineer will do his part and will cope with each situation as it arises, as he has always done." His address, entitled "A Century of Progress in California," is being published in the Centennial volume of TRANSACTIONS, now in preparation.

Award of the Daniel W. Mead Student Prize to Charles E. Negus, Jr., J. M. ASCE, of Auburn, Calif., was another feature of the opening session. Mr. Negus received the award for a paper written last year while he was a member of the Society's Student Chapter at the University of California.

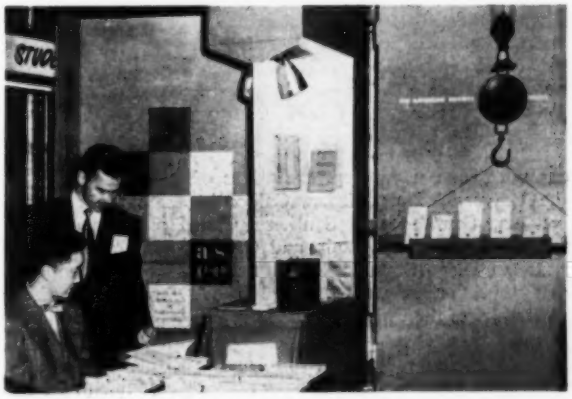
Top brass of San Francisco Convention committees includes (left to right) L. L. Wise, publicity chairman; C. A. Trexel, chairman of technical program; L. A. Elsener, general chairman; ASCE President Walter L. Huber; J. G. Wright, president of San Francisco Section; and M. M. Falk, vice-chairman of registration.

Construction Experts Foresee Prosperity

No fears for the future of the construction industry were expressed by experts taking part in a panel program of the Construction Division, which was one of the highlights of the technical program. Discussing the "Effect on the Construction Industry of a Reduction in Defense Spending" as an economist, James I. Ballard, editorial director and vice-president of King Publications and *Western Construction News*, San Francisco, said that economists expect no marked change "in the national climate that today favors a record construction volume." He pointed out that "construction activity will always be related to population growth." Other speakers in the panel of experts concurred in this viewpoint. Arthur E. Poole, chairman of the Executive Committee of the Construction Division and president of the Hallen Co., Long Island City, N.Y., spoke on government aspects of the subject, and Hugh Abernathy, general manager of investment and assistant treasurer of the Prudential Insurance Co., Los Angeles, spoke from the financial point of view.

Presenting the construction viewpoint, John P. Yates, senior vice-president of the Bechtel Corp., San Francisco, remarked that, "Under the most favorable world political conditions we can anticipate that our country must maintain a relatively high level of defense spending even after the peak is reached this year. I am not certain that construction as a whole will slow down appreciably. It may reach even higher levels before 1960." Defense construction spending, he noted, "is a relatively small portion of total defense spending, so if that spending does essentially stop it will not have a marked effect on the total economy," Mr. Yates also pointed out that a possible drop in defense spending "could easily be more than offset by the increase in foreign spending—not foreign aid but real investment by private capital. . . . . The United States is becoming world dominant, and the market for foreign construction is enormous. From the United States work is carried on in all the important foreign areas." He summed up, "We had better be able to handle effectively an increase in construction activity."

Exceptional program of ladies' activities for the Convention is headed by Mesdames Arthur C. Horner, L. A. Elsener, W. L. Huber, James I. Ballard, and Jonathan G. Wright, all of San Francisco. Mrs. Elsener was chairman of the ladies' program.



Helpful Junior Members of the San Francisco Section man the portable exhibit of ASCE publication, at which record sales were made. Shown are Ralph Fong (seated), of Dames & Moore, and George H. Speers, of Bechtel Corp.

Wide Sale of Preprints

The underlying theme of most of the technical papers—presented by eleven of the Society's thirteen Technical Divisions—was growth, all over the United States and particularly in California, and the necessity for measuring future plans in terms of such growth. Attesting to the exceptional interest in the technical program is the fact that the sale of preprints of papers presented was the largest on record, with some editions exhausted. Remaining preprints may be purchased from Society headquarters at the usual price of 25 cents a copy.

Contributing also to interest in the preprints was a new portable exhibit of ASCE publications, arranged in panel form. Devised for circulation at Local Section meetings and conferences and at meetings of other organizations, the unit has interchangeable doors and panels to permit display of publications appropriate to the occasion. During the Convention this display was manned by Junior Members of the San Francisco Section.

Notable Speakers Heard

The outstanding social program included two luncheons of more than passing interest—the Wednesday Membership Luncheon and a luncheon sponsored by the San Francisco post of the Society of American Military Engineers. Dr. Robert Gordon Sproul, president of the University of California, gave the principal address at the Wednesday luncheon. A civil engineering graduate of the University of California, Dr. Sproul spoke on "Engineering Education," expressing doubt that the average person is ignorant of the great contribution of engineering to our progress. He said that great credit is due the engineering societies for their frank criticism of and aid to engineering colleges, resulting in what he called a "healthy partnership" between the two. Dr. Sproul also stressed the importance of a good relationship between faculty and students. In the main, he finds high school graduates well equipped to undertake engineering studies.

Maj. Gen. Hayden L. Boatner, deputy commander of the Fourth Army, warned the large audience at the S.A.M.E. luncheon on Friday that we must not underestimate the fighting qualities of the Chinese Communists and the North Koreans. He said that a stalemate has developed in Korea, but that even a stalemate is better than evacuation. General Boatner is famed for his clean-up of the Koje Island prisoner-of-war camp in Korea in May 1952.

Large Student Conference Held

Some 250 Student Chapter members attended an all-day Student Chapter Conference on Monday that featured a student paper contest. The $50 first prize went to Lyle N. Hoag, Jr., president of the Student Chapter at the California Institute of Technology, for a paper on "Vibration Compaction of Soil." His victory, the fifth for Caltech in the past six years of competition, was won in a

Assembling in Honolulu for opening session of post-convention phase of ASCE San Francisco Convention are these engineer visitors from the mainland (left to right, front row): ASCE Director Louis R. Howson, Chicago; Executive Secretary W. N. Carey, New York; H. W. Dennis, Los Angeles; S. W. King, governor of Hawaii; ASCE Past-President W. W. Horner, St. Louis; Robert J. Trier, Washington, D. C.; and Damon Runyan, Denver, Colo. In same order, back row, are George Camp, Mexico City; William W. Brewer, Jr., Mark Falk, Robert Dewell, and Arthur C. Horner, San Francisco; ASCE Director Francis S. Friel, Philadelphia; and Robert Kennedy, San Francisco.

contest with student representatives of the Universities of Arizona, California, Nevada, Santa Clara, Southern California, Stanford and Utah, and Oregon and San Diego State Colleges. Second and third prizes went to Ralph W. Evans, Jr., of the University of Utah, and Bill G. Crockett, of the University of Arizona.

California Conference Meets

The many events of the Convention week included the annual California Conference of Local Sections, which combined its technical program with that of the Convention. The business agenda of the California Conference (now renamed to include other Sections in the area) is reported elsewhere in this department. In addition, there was a Local Section Conference.

Local Publicity Obtained

With a fine sense of timing the local publicity committee, under the chairmanship of L. L. Wise, released the Section's final choice of "seven civil engineering wonders" in the Bay area to coincide with the Convention. Compiled at the request of the Society, which began a study of engineering wonders as a phase of the Centennial program last year, the list was released at the time of the Convention for a two-fold purpose—to list outstanding works for the benefit of members visiting San Francisco, and to implement a newspaper, radio and television campaign aimed at telling the local public what the profession has done for it. In addition to considerable newspaper publicity obtained for the Convention, there were ten radio and TV programs. CBS alone gave four unasked-for plugs including two mentions of the seven wonders.

The seven wonders, as determined by Section officers, past and present, are: the Golden Gate Bridge, longest suspension span in the world; (2) the San Francisco–Oakland Bay Bridge—a combination of two suspension bridges, a tunnel and a cantilever bridge; (3) the Union Square Garage, a four-story underground parking structure, the first of its kind anywhere in the world; (4) the Hunters Point Crane at the San Francisco Naval Shipyard with lifting capacity of 504 tons making it the largest crane in the world; (5) the Moffett Field wind tunnels, said to be one of the greatest assemblies of wind tunnels in the world; (6) Treasure Island in the middle of San Francisco Bay, one of the largest man-made islands ever built; and (7) the Oakland–Alameda Tube, a 24-ft-wide highway connection between Oakland and Alameda under the Oakland estuary, which was completed in 1928 making it the oldest of the seven wonders.

Post-Convention Trip to Hawaii

At the conclusion of the San Francisco phase of the program, about 15 fortunate ones took off by air for Honolulu and the meeting of the Hawaii Section that officially concluded the San Francisco Convention program. Both the Hawaii and Sacramento Sections were co-sponsors, with the San Francisco Section, of the Convention program. Great credit is due the hard-working local committees that made the Convention one long to be remembered. L. A. Elsener was general chairman; C. A. Trexel, chairman of the technical program; Mrs. L. A. Elsener, chairman of ladies' activities; and R. M. Belt, chairman of the Hawaiian Post-Convention Tour.

Action of Board of Direction at San Francisco Briefed

All but one member of the ASCE Board of Direction was present at the San Francisco meeting of the Board on March 2 and 3. The principal business of the two-day meeting is summarized here.

Formation of Subsections Encouraged

To encourage the formation of Branches or Subsections within the Local Sections, the Executive Committee has recommended and the Board approved direct allotment of $50 to each new Branch or Subsection formed during the year, plus an annual payment of $50.

Manuals on Consulting Practice

President Huber appointed, and the Board approved, the following members to serve on an ASCE–ASME Joint Committee on Manuals to investigate a coordinated plan for developing and issuing manuals on consulting practice: Gustav Requardt, chairman, N. T. Veatch and C. E. Beam.

Two More Regional Councils Authorized

Approval was given to establishment of a New England Council of Local Sections, and to the establishment of a District 14 Council.

Delaware Section Established

On approval of the Philadelphia Section and the recommendation of the Committee on Local Sections, the Board voted Local Section status to the former Delaware Subsection.

University of Houston Student Chapter Authorized

On recommendation of the Committee on Student Chapters, the Board authorized the formation of a Student Chapter at the University of Houston in Texas.

Technical Procedure

Chairman George W. Burpee an-

nounced that the next meeting of the Technical Procedure Committee will be in August 1953.

Publication of Proceedings Separates to Be Expedited

On recommendation of the Committee on Publications, the Board adopted the photo-offset method of publishing Proceedings Separates (both papers and discussions). For the present every paper recommended by a Technical Division for publication will be produced by photo-offset from the typewritten manuscript without pre-editing. They will then be distributed *automatically* and without charge to members of the Society, in the Division recommending the paper, who listed the Division as their first choice. As at present all Separates so reproduced will be listed in CIVIL ENGINEERING. Members may order, at 25 cents each, Separates from Technical Divisions other than those of their first choice by clipping a coupon and mailing it to the Executive Secretary. The change-over to the new system will be put into effect as quickly as practicable. Watch subsequent issues of CIVIL ENGINEERING for further details. Facts on the new procedure were ordered sent to officers of the Technical Divisions, professional committees, and Local Sections, Subsections, and Branches.

Samuel W. King, governor of Hawaii, receives President Huber's greetings from Executive Secretary W. N. Carey at opening of spring meeting of Hawaii Section at University of Hawaii. Left to right, are G. C. Wallace, president of Section; Mr. Carey; Governor King; and Gregg Sinclair, president of university.

Expanding Society Services Studied

As the result of a formal request made by the California Conference of Local Sections at its meeting in San Diego in May 1952, and of informal requests of a similar nature from other Local Sections, a Board committee has made a study of what might be done to expand services to ASCE members if additional funds were available. Chairman Burpee's report is published elsewhere in this issue.

Appointments

A M Rawn to the John Fritz Medal Board of Award; G. Donald Kennedy to the Washington Award Commission; Prof. Frank Kerekes to ACI Committee 315 on "Manual of Standard Practice for Detailing Reinforced Concrete Structures"; and Harold L. Lewis to the Engineering Societies Library Board.

Formation of New Sanitary Engineering Group Discussed by ASCE Sanitary Engineering Division

A proposal to establish a new sanitary organization, called the American Institute of Sanitary Engineers, was explored at a recent special meeting of the Executive Committee of the Sanitary Engineering Division. Representatives of the group—Rolf Eliassen, Alvin Meyer, and Harvey Ludwig—were present at the meeting. Also present were H. W. Carstain for the American Water Works Association; W. E. Wisely for the Federation of Sewage and Industrial Wastes Associations; Frank Elder for the American Public Health Association; and Earnest Boyce for the Joint Committee for the Advancement of Sanitary Engineering.

While recognizing the thought-provoking service that the proponents of the proposed AISE have done for sanitary engineers, most of those attending the meeting were strongly of the opinion that establishment of another organization in a field already crowded should be thoroughly explored by the Joint Committee for the Advancement of Sanitary Engineering. The Executive Committee asked that the proposal to set up the American Institute of Sanitary Engineers be deferred until the Joint Committee has an opportunity to examine the matter fully at its July meeting. Representatives of the AISE, two of whom are on the Joint Committee, agreed to the proposal.

Significant in the whole discussion was the general agreement that something must be done for the sanitary engineer, particularly for those working in public health organizations. There is an urgent need for certification of professional and technical competence so that the engineer can serve with equal stature on teams of public-health specialists. One proposal to be explored and reported on is the establishment of a Specialty Board, perhaps within Engineers Joint Council. Such a board would give examinations, evaluate education and experience, and award certification. A sanitary engineer could request certification through any one of the Founder Societies.

Reactions to this proposal will be welcomed. They should be sent to John C. Bumstead, Secretary, ASCE Sanitary Engineering Division, 2933 Woodburn Avenue, Cincinnati 6, Ohio.

Rocky Mountain Conference Of Student Chapters Planned

Student Chapters of the Rocky Mountain area will be guests of the University of Denver Student Chapter at a regional conference of Chapters on Saturday, May 9. The Rocky Mountain Conference Chapters are at Colorado A & M College, the University of Colorado, the University of Denver, New Mexico A & M College, the University of New Mexico, South Dakota School of Mines & Technology, Utah State College, the University of Utah, and the University of Wyoming.

Convening at the Student Union at 8:45 a.m., the conference will include a paper contest for graduate students and a separate contest for undergraduates, and a discussion of policies and plans for future conduct of the conference. Opportunities for getting acquainted will also be featured.

Officers of the University of Denver Chapter, as host, are functioning as conference officers, and the members of the Chapter are acting as the executive committee of the conference, William G. Allen, president of the Denver University Chapter, is in charge of arrangements.

Miami Beach Engineers Plan for June Convention of ASCE

"An Engineering Convention in an Engineering Wonderland" would be an appropriate title for the Miami Beach Convention of the Society, to which the Miami Section will be host, June 17–19. A fabulous resort and wealthy residential city has grown on a strip of mangrove swampland through the efforts of engineering genius and the vision of pioneers. And for the period of its most rapid development Miami Beach has had for its city manager Claud A. Renshaw and for its city engineer Morris N. Lipp, both ASCE members.

Sixteen technical sessions are currently included in the program being arranged by Col. Lynn Perry, technical program chairman. Agendas have been arranged and approved for the Surveying and Mapping, Structural, Air Transport, Soil Mechanics, Irrigation and Drainage, and Highway Divisions. Programs have been submitted but not arranged for the Sanitary, Engineering Mechanics, City Planning and Construction Divisions.

To show Convention visitors first hand the "Seven Engineering Wonders of South Florida" field-trips are being arranged to the recently completed Cutler Plant of the Florida Power & Light Co.; the flood control works of the Everglades Drainage District; the City of Miami water works now under construction; and Miami International Airport, second busiest air terminal in the world. The University of Miami has offered to display its laboratory for hurricane testing of buildings and building materials.

Miami Section members meeting at luncheon to assist in preparations for coming Convention of ASCE to be held at Miami Beach are (left to right): H. H. Hyman, president of Miami Section; W. C. Gorman, hotel and registration chairman; W. J. Knox, finance committee chairman; Mrs. Knox, ladies program; C. F. Wertz, general chairman; H. J. Morrison, entertainment committee chairman; Leroy Edwards, publicity committee chairman; William Sussman, publicity committee co-chairman; and R. W. Hart, secretary of Miami Section.

Arrangements are also being made for a post-convention trip to view the construction of the Tampa Bay Bridge in which prestressed concrete is being used for approximately $3^1/_2$ miles of trestle. G. E. Watson is chairman of the committee arranging the excursions.

To entertain convention visitors the Entertainment Committee, of which H. J. Morrison is chairman, is planning a cocktail party and aquacade. For another evening a dinner and dancing under the stars, on a patio overlooking the ocean, are being arranged. These events will make the most of the city's tropical allure. Of course, there will also be swimming, water-skiing, deep sea fishing and golf (green fees gratis to Convention guests).

With student interest in the Convention showing a sudden increase, Prof. Murray I. Mantell, of the University of Miami, has started work on a program for the embryo engineers.

The work of coordinating the various committees is being handled by C. F. Wertz, general chairman, who promises an interesting and varied program for all who attend. Add the things that annually attract over a million visitors to Miami Beach, and every Society member should feel that attendance at the Convention is a "must."

Headquarters for the Convention will be the Casablanca Hotel, one of the newest luxury hotels which was designed especially for conventions. Convention guests will also be housed at the adjoining Coronet and Martinique hotels, each with its own dining room, swimming pool, beach and cabanas. Reservations are being made by a committee headed by W. C. Gorman, as chairman, and inquiries should be addressed to him at the Casablanca Hotel, Miami Beach.

Pacific Northwest Conference of Local Sections Will Meet in Seattle, Wash., April 30–May 2

Many multi-million-dollar construction projects in the Pacific Northwest will be discussed at the spring meeting of the Pacific Northwest Conference of ASCE Local Sections, to be held April 30, May 1 and 2 in Seattle, with the Seattle Section as host. Among these projects, which are now "on the boards," are such controversial subjects as the Seattle freeway plans, the bridging of Puget Sound, and the piping of natural gas to the Pacific Northwest. The wide range of topics will also include highway, marine and air traffic development and power and fuel needs of the area.

The keynote address will be given by Walter A. Averill, vice-president and publisher of the *Pacific Builder and Engineer*, Seattle, who recently retired from the chairmanship of the Puget Sound Engineering Council. He will discuss the rapid growth of the Pacific Northwest and the engineer's role in its economic development.

Ladies' activities tentatively planned will include a boat trip, shopping tour and tea. A banquet will close the meeting.

Conference officers will meet April 30 to nominate their successors. Present conference chairman is J. E. Travis, assistant manager of Hanford Works Operations. Byron J. Clark, project engineer, Seattle District, Corps of Engineers, is vice-chairman, and M. B. Nelson, city engineer of Richland, Wash., is secretary-treasurer. Mr. Clark is general chairman for the conference. Other chairmen are: S. Charles Dearstyne, program; C. M. Barr, finance; H. K. Johnson, publicity; H. D. Dennis, registration and housing; A. C. Koch, reception; and F. H. Rhodes, student activities.

Steinman Bridge Lecture Available to Students

For the convenience of Student Chapter and other engineering groups, D. B. Steinman, M. ASCE, has generously made a gift to the Society of a recording of his illustrated lecture entitled "Romance of Bridges," which he has delivered in person many times before engineering groups. The lecture, which is on three long-playing records to be run at a speed of $33\frac{1}{3}$ rpm, may be borrowed by student and engineering groups. Colored $2'' \times 2''$ slides of the various structures discussed accompany the lecture. Inquiries should be addressed to ASCE headquarters.

Developing the thesis that bridges must be aesthetically pleasing and in harmony with the particular landscape where they are erected as well as feasible from the standpoint of design, the lecture makes its own point by reference to a number of beautiful bridges—many of them Dr. Steinman's own.

Transition of Students from Chapters to Sections Aided

A procedure for bridging the gap between Student Chapter and Local Section participation in Society activities is being perfected by the ASCE Committee on Student Chapters. When a member of a Chapter graduates he will receive a card, signed by his Faculty Adviser, that will introduce him to officers of the Local Section in the area where he expects to work. His Faculty Adviser will also notify the secretary of the Local Section that the graduate is coming and where he can be reached. By this procedure, the student is enabled to make contact with a Local Section, even before the longer procedure of electing him to Junior Membership becomes effective.

In a summary of committee efforts to help graduates from Student Chapters get into the swing of Local Section work, Prof. Leo C. Novak, chairman of the Committee on Student Chapters, suggests that employers of new graduates should also encourage them to take part in Section activities.

Local Sections must review their programs to make sure they are attractive to the younger members, Professor Novak advised. "The whole problem is a challenge to members at all levels of the Society and its organization. Committee and individual efforts must be continued in this direction for the development of an active and interested membership."

Sanitary Engineering Division Expands Its Program

A broad program of professional and technical activity on an intensified scale was adopted by the Executive Committee of the ASCE Sanitary Engineering Division at a special meeting held in Chicago on February 20 and 21. The committee took a strong stand in favor of full cooperation with other professional and technical organizations with allied interests.

Increased technical activity will cover a broad field: Industrial wastes, atmospheric pollution, water treatment, infiltration to sewers, sewage treatment, and refuse collection and disposal. In two of these fields—industrial wastes and atmospheric pollution—the committee has set up task committees to explore and, if advisable, recommend a program of technical activity for the Sanitary Engineering Division. Special effort will be made in these studies to consider the diverse economic and professional interests represented in the two fields.

Radiological health and sanitary engineering is another field that will be covered by a new committee of the Sanitary Engineering Division. Conrad Straub was named chairman, and the contact member is Roy J. Morton.

To encourage sanitary engineering activities in Local Sections, a new Committee for Cooperation with Local Section Sanitary Engineering Committees was set up, with Ralph Fuhrman for contact member. Local Section members who would like to get into sanitary engineering activities on a grass-roots basis should get in touch with Mr. Fuhrman.

The Executive Committee authorized development of a series of Manuals of Practice. Manual No. 19 (*Water Treatment Plant Design*), published twelve years ago, will be revised and expanded to include developments and improvements of the forties. This project will be carried out under the direction of the Committee on Water Supply Engineering, of which Ernest W. Whitlock is chairman. Cooperation with the American Water Works Association will be solicited. Manuals on infiltration and sewage treatment plant design will be developed and prepared through the Committees on Infiltration and Loss in Sewage Collection Systems (George R. Thompson, chairman) and Sewerage and Sewage Treatment (Kerwin L. Mick, chairman). Coordination of these projects with activities of the Federation of Sewage and Industrial Wastes Associations will be sought.

Refuse collection and disposal, a field in the throes of development and expansion, came in for special attention by the Executive Committee. To meet the urgent need for a body of authoritative technical knowledge in the field, the Executive Committee is proposing the establishment of several task committees, each organized to produce a manual on a particular phase of the municipal refuse field. Organization of the program will be worked out by H. W. Taylor, chairman of the Committee on Refuse Collection and Disposal, and B. A. Poole, contact member for the Executive Committee on this activity.

It is planned to have the Manuals of Practice prepared by task committees within the standing committees of the Division. To staff these task groups, the Executive Committee would like to hear from sanitary engineers with time for and interest in professional service. Members wishing to contribute their technical experience to this project should write to Prof. H. B. Gotaas, chairman of the Executive Committee, S. E. D., University of California, Berkeley 4, Calif., telling him what their speciality is and what activity they would like to participate in.

Attending meeting of Executive Committee of Sanitary Engineering Division in Chicago are (seated, left to right) Rolf Eliassen, B. A. Poole, Frank Elder, H. B. Gotaas (chairman), Earnest Boyce, W. H. Wisely, Ralph Fuhrman, and Roy Morton. Standing, in same order, are Alvin Meyer, John Bumstead, Frank Erickson, Harvey Ludwig, H. H. Gerstein, and Don Reynolds, assistant to the Executive Secretary.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Supreme Court Decision Affects Engineers

An important decision has just been handed down by the United States Supreme Court in connection with the controversial Roanoke Rapids power development project. The litigation involved the relative powers of the Interior Department and the Federal Power Commission with respect to power development. In the Flood Control Act of 1944, Congress approved a comprehensive plan for improvement of the Roanoke River Basin. The plan included various proposed structures for flood control, navigation and power development. No specific authorization bill for construction of any specific structures had ever been passed. The Interior Department contended that the plan *presupposed* federal development of all the sites within the basin and precluded FPC approval of private applications for the development of any of them. The Department sought to obtain court action to prevent the Federal Power Commission from licensing the Virginia Electric and Power Co. to build a power plant at Roanoke Rapids. In the majority opinion the court supported the Federal Power Commission's contention and refused to interpret the approval of the plan by Congress as a withdrawal of the FPC licensing authority. The new Secretary of the Interior appears to have no objection to the building of a private plant at such a site.

There was a vigorous dissent by Justice Douglas, in which the Chief Justice also joined, holding that the site was a part of the public domain and that the approval of the plan did reserve all the area for federal development. In the dissent it was stated that the private interests had taken the most desirable power site leaving the others for federal development; that in fact the private interests will be benefited to the extent of $700,000 per year by the government construction of another project in the approved program.

This decision should not be interpreted as applying in the case of a project for whose construction a specific authorization act has been passed.

Legislation

Various bills that have heretofore been mentioned as directly affecting civil engineering are still in committee with little to report. According to a statement by the president of the A. F. of L., that organization will propose the elimination of the "professional employees" provisions in the Taft-Hartley Act. These provisions were added to the act, following presentation of testimony in favor of them by a panel under the sponsorship of Engineers Joint Council. The panel will participate in hearings on the new bills.

The bill to permit review by the courts of the decisions of government contracting officers in disputes under government contracts (S.24) was reported favorably to the Senate by its Judiciary Committee, and placed on the Senate's calendar of noncontroversial bills. However, objection by two Senators prevented action in the Senate. A similar bill, H.R. 1839, is under study by a committee in the House. The National Affairs Committee of ASCE has sent a communication to this committee favoring the passage of such legislation. Professional services contracts as well as construction contracts are involved.

Reorganization of the Construction Industry

An important meeting of Construction Industry groups took place on February 25 and 26 in Washington. Interesting highlights of the meeting were a discussion of taxation, led by Chairman Reed of the House Ways and Means Committee, and a discussion of labor management problems led by President Gray of the A.F. of L. Building Trades Department. The primary purpose of the meeting was to perfect some joint group to deal with problems of common concern. Difficulties with NPA regulations during the past two years have forced the construction groups into something resembling a working unit. ASCE handled the problem of alleviating the impact of NPA regulations and controls on engineers through cooperation with these groups. This has now resulted in a reorganization of the Construction Industry Advisory Council under the general auspices of the U. S. Chamber of Commerce.

The special committee on reorganization considered the loose "forum" type of organization and the tight "operative" type. In the latter the combined organization would attempt to speak as an industry, representing all the constituents. This idea was rejected and the "forum" type of organization was adopted, following the pattern of the National Conference on Construction of the early 1930's. Such an organization provides a meeting place for the component organizations to exchange views and iron out differences of opinion on proposed action without binding any constituent group in any matter. The Council will operate under the general sponsorship of the U. S. Chamber of Commerce which will furnish staff assistance and underwrite overhead expenses as part of the service of its Construction and Civic Development Department to the construction segment of the economy.

ASCE has been an active participant for some years, and in fact has furnished the leadership of the group through the services of Past-Presidents J. C. Stevens and Carlton S. Proctor who have been chairmen during recent years. The Field Representative served as Technical Director of the original construction industry group on which the new organization is patterned. Past-President Ezra Whitman has been selected as the new chairman of the reorganized Council.

In this column for February, actions of the National Joint ASCE-AIA Committee were reported. Since then the AIA Co-Chairman has sent out an appeal to local AIA Chapters to resolve any potential disputes between engineers and architects at the local level so that the valuable cooperative work between the two societies at the national level will not be jeopardized. ASCE Sections could well follow this same procedure of eliminating such sources of friction in their early stages at the local level.

Controls

Construction controls are rapidly passing into history. The Office of Defense Mobilization states "The Government does not intend to continue to control the distribution of steel, copper and aluminum in the civilian economy after June 30, 1953, under the Controlled Materials Plan." During the first half of March an order was issued permitting suppliers and customers to change delivery dates on a rated order. When the Controlled Materials Plan is terminated on June 30, a new defense materials system is proposed. This will relate to the allotment of materials for military projects. Except for nickel-bearing stainless steel, all non-defense allotments for the third and subsequent quarters will be cancelled and free market conditions allowed to prevail.

Washington, D.C.

March 19, 1953

ASCE MEMBERSHIP AS OF MARCH 9, 1953

Members	8,309
Associate Members	10,506
Junior Members	17,050
Affiliates	68
Honorary Members	42
Total	35,975
(March 10, 1952	34,378)

Study of Expanding Society Services Reported by ASCE Task Committee

GEORGE W. BURPEE, Vice-President ASCE, Chairman
WALDO G. BOWMAN, former Director, and
FRANCIS S. FRIEL, Director

The following report of the Board of Direction's Task Committee on Expanding Society Services to members has been prepared as a result of a formal request by the California Conference of Local Sections, made during its May 1952 meeting in San Diego, and informal requests for similar information made by other Local Sections. At the Denver meeting of the Board on June 17, 1952, the President, in compliance with the instructions of the Board, appointed the members of the Board named above as:

A Task Committee to consider what might be done to expand the Society's services to its members if additional funds were made available. The Task Committee was directed to consider separately each possible extension of service, its related expense and the increase in dues necessary to implement the service.

The Committee submitted an interim report to the Board at the latter's meeting in New York on October 14, 1952. Continued study of the matter has resulted in the report that follows.

The services rendered by the Society to its members may be classified generally as: (*a*) technical, and (*b*) professional.

The dividing line between these functions is not clear cut because our technical and professional activities overlap but for purposes of this report we have defined "technical" as including:

1. Publications, and
2. Activities of the Technical Divisions

and "professional" as including:

1. Activities of the Committee on Conditions of Practice and related committees, and
2. Activities of the Local Sections

It might be said that technical activities should be designed to help the individual member increase his knowledge of the scientific aspects of engineering and to keep up with progress in the art; and, that professional activities should be designed to help engineers, working together, to improve their usefulness to society and to increase their influence therein.

Technical

The technical activities which appear to be of greatest interest to the membership are "Publications" and "Technical Division Activities" which are dealt with below.

Publications

Many of our members regard the Society's technical publications as its greatest contribution to the profession, and almost half of the annual expenditures are allotted to this department. And yet there is a very pronounced opinion that the number of PROCEEDINGS papers published is wholly inadequate and that the time which elapses between the receipt of a paper and its publication is so long (about 18 months) that potential contributors are discouraged from presenting papers to our Society and sometimes contribute them to one of the various societies with collateral interests. We do not intend to trespass on the field of the Committee on Publications but merely to present some facts as to what can be done with an increase in funds available.

The Executive Secretary has presented to the Board of Direction a comprehensive report on "Publications" suggesting certain changes in procedures for publishing PROCEEDINGS, mainly by the use of the photo-offset process of reproduction and by the elimination of initial editing except by the author, whereby the cost of printing can be reduced and, more important, the papers can be reproduced with little loss of time. In brief the report recommends that *all* papers, whether for convention sessions or for PROCEEDINGS, which are cleared by the Technical Divisions or appropriate Society committees shall be published immediately, using the photo-offset process. By this means it would be practicable to publish 300 or even more papers each year. The most outstanding of these papers could be printed in the annual TRANSACTIONS.

Additional staff members would be necessary to handle the distribution of the enhanced number of papers but the editorial work would be confined to TRANSACTIONS papers and hence be little if any greater than at present. Allowances would be made to the Technical Divisions to handle the greatly increased volume of work for which the Divisions would be responsible. The adoption of some such program would make desirable some rearrangement of the Publications Department at headquarters.

The estimated additional annual cost of a program of this type and magnitude, including additional payroll, travel and rearrangement of the entire Publications Department, totals $71,500.

Technical Divisions

The Technical Divisions are the instrumentalities whereby scientific and technical progress in civil engineering are stimulated and advanced. The 13 Divisions have an enrolled membership of approximately 58,000; but eliminating second and third choices, the number of individual members involved is 22,000, about 63 percent of the membership of the Society.

It has become evident that the burdens placed on the headquarters staff by increasing membership have been so great as to restrict the time available for effective coordination of Division Activities. At the meetings of the Committees on Technical Procedure and on Division Activities in Chicago in September 1952, it was apparent that a headquarters organization adequate to coordinate the work of these various committees, was a prime necessity.

Since the Technical Divisions are now the principal generators of PROCEEDINGS papers, it has been suggested that each Division be allotted $1,000 for part-time secretarial work. This is particularly desirable in view of the anticipated great increase in number of papers. This will cost $13,000 a year. Additional supplies and postage will require an additional $500.

Making allowance for necessary additional staff assistance and travel, the total estimated additional cost for Technical Divisions thus becomes $22,500.

Professional Activities

The professional activities in which our members appear to be most interested are those carried on by the various committees now grouped under the newly constituted Committee on Conditions of Practice, and the work of the Local Sections.

Conditions of Practice

The committees included within the scope of this general committee may be grouped in accordance with their functions as follows:

1. Coordination of Professional Activities
   Professional Practice
   Registration of Engineers
2. Application Classification
   Membership Qualifications
   Local Qualifications
3. Engineering Education
   Student Chapters
   Junior Members
4. Employment Conditions
   Salaries
5. Local Sections

These committees function through their committee meetings, through conventions, and largely through the Local Sections and Student Chapters, in working for the advancement of the engineer as a professional man and his recognition as such. Through headquarters the committees coordinate their activities with such organizations as EJC, which is devoted to professional advancement of engineers in all branches of engineering.

The new over-all committee will require some strengthening of the headquarters staff to permit an Assistant Secretary to devote more time to coordinating the professional activities and Local Sections.

Provision must be made for meetings of the committees and for additional travel. Work with the Student Chapters is particularly important. There are now 132 Student Chapters with over 7,500 members. These represent potential future members of the Society. More frequent contact with headquarters and with the elected officers and Directors of the Society would stimulate the interest and tend to gain the support of these prospective members. The estimated annual cost of a reasonable expansion of professional services is $24,000.

Local Sections

There are now 73 Local Sections with 43 Subsections with a total of 14,314 dues-paying members. The present allotment is based on $50 a Section and $1.00 for each dues-paying member. This Committee hesitates to suggest a new formula or a categorical increase but does suggest that the present allotment of $19,000 might be increased by 100 percent, or say $20,000. The method by which this should be applied should be subject to consideration of the Local Sections Committee. The $20,000 additional would be made available to Local Sections as additional allotment and to provide for more Local Section conferences, etc., as further study may determine.

Costs of additional services

These expanded services and their annual increased expenditures are summarized as follows:

Technical Services:	
Increase in PROCEEDINGS papers to 300 per year	$ 62,000
Rearrangement of Publications Department	9,500
Technical Divisions—increased coordination and provision for part-time secretaries for preparation of papers	22,500
Professional Services:	
Conditions of practice—meetings of various committees, visits to Local Sections, additional assistant on headquarters staff	24,000
Local Sections—for additional Local Section conferences and such other stimulation of Local Section activities as may be warranted	20,000
Finance and Accounting:	
Some additional clerical help, travel, and supplies—needed because of the growth of the Society	7,500
Totals	$145,500

Staff Travel

We believe that the membership can gain much by closer contact with the headquarters staff—more visits to Student Chapters and Local Sections in particular—and the stimulation of the interest of the Local Sections in Technical Division activities.

Provision for additional staff travel has been included in the foregoing analysis.

Headquarters Organization

During the past five years the growth of membership of the Society has run ahead of increases in staff personnel. In 1952 the membership was greater by 13,000, or 60 percent, than at the end of the fiscal year 1947. The headquarters staff has been little changed and the payroll has been increased only 17½ percent. While perhaps it is beyond the scope of this Committee's function to suggest changes in the existing organization at headquarters, it is evident that properly to serve our increasing membership certain additions are necessary, primarily in the addition of men of the caliber that can be developed within the next five years or so to positions of responsibility. In so far as is possible, the Executive Secretary has organized his staff along the following lines:

Technical Divisions Department
Publications Department
General Services Department
Finance and Accounting Department

Because of shortage of personnel, some of the Assistant Secretaries have to function in more than one capacity. The additions suggested in the foregoing material will permit more effective functioning along these departmental lines.

Included within this category and not mentioned under either technical or professional services is the matter of the Comptroller's office. It is suggested that an allowance be made for a moderate increase in the salary of the Comptroller and some additional clerical help, amounting in total to $6,000; and $1,500 for other expense, making a total of $7,500.

The Executive Secretary estimates, and we concur, that essential increases in personnel as set forth above represent new annual demands of $42,000. We are of the opinion that this moderate increase in staff will result in a more than commensurate service to members.

Conclusions

The range in the estimated increased collections, here tabulated, is from $63,000 to a high of $162,500. In the Committee's opinion a more reasonable top figure would be $145,000 which, by a coincidence, is the estimated annual cost of desirable expansions and improvements to services as set forth above. With the minimum increase in dues it would be possible to do little more than increase the publications somewhat and strengthen the headquarters staff to secure better coordination than is now possible for technical and professional activities. The Committee has considered an increase of over $5.00 a year for Members and Associate Members but believes that an increase of over $5.00 would pass the point of diminishing returns.

It is reasonable to anticipate some loss in membership due to any dues increase. The Committee is not herein attempting to estimate the amount of such loss. It is evident that at such time as the increased income may become available, the final disposition of the increase may not follow the pattern set forth above. The Committee believes that the figures given are in sufficient detail to permit the Board members and Local Sections' officers to compute the effects of allocations to various activities that may differ from those suggested above.

The Committee is not expressing any opinion on the question of whether dues should or should not be raised or, if raised, on what basis the increase should be made; it has presented factual material as to increases in services which it believes to be desirable, the estimated cost of such expansions in services and annual amounts available on various bases of dues.

Funds available from increases in dues

For this purpose the membership of the Society may be taken as follows:

Members, Associate Members, and Affiliates	18,500
Of whom Life Members constitute	2,500
Leaving dues-paying members of above grades	16,000
Junior Members	16,500
Total dues-paying members, all grades	32,500
Of these there are resident in the Metropolitan Section:	
Members, Associate Members, and Affiliates	2,100
Junior Members	1,300
Total, all grades	3,400

A number of combinations for increasing dues were considered by the committee. These ranged from a low with a total increase of $63,000 to a high combination totaling $162,500. Three of the eight combinations developed are shown below. Using the membership table previously shown, any number of combinations may be developed as desired.

A. Five dollars increase across the board—32,500 at $5. . . $162,500

This means $25 for Members and Associate Members and $15 for Junior Members in Districts other than the Metropolitan Section, and $30 for Members and Associate Members and $20 for Junior Members in the Metropolitan Section.

B. Twenty-five dollars dues for Members and Associate Members and fifteen dollars dues for Junior Members—all Districts

Members and A.M.:	13,900 at $5	69,500	
Junior Members:	15,200 at $5	76,000	$145,500

This represents a $5 increase for members of all grades outside the Metropolitan Section and no change for those resident in the Metropolitan Section.

C. Twenty-five dollars dues for Members and Associate Members
Ten dollars dues for Junior Members

This is a $5-a-year increase for Members and Associate Members outside the Metropolitan Section and a $5 reduction for Junior Members in the Metropolitan Section, Members' and Associate Members' dues in the Metropolitan Section and Junior Members' dues outside the Metropolitan Section remaining the same as at present.

Members and A.M.:	13,900 at $5	$ 69,500	
Junior Members:	Less 1,300 at $5	−6,500	$ 63,000

Proceedings of Fourth International Congress on Large Dams Available

Availability of the Transactions of the Fourth Congress of the International Commission on Large Dams, held in New Delhi, India, in January 1951, is announced by C. P. Vetter, M. ASCE, chairman of the United States Committee on Large Dams. The Fourth Congress discussed four subjects, each of which is treated in a separate volume.

In Volume I is discussed the subject referred to as "Question No. 13: Design and Construction of Earth Dams and Rock-fill Dams with Their Core Walls and Diaphragms." William R. Creager, consulting engineer from Buffalo, N.Y., presents a summary of the papers submitted on the subject. The summary is given in both English and French and is followed by the complete texts of 23 individual papers. Volume II discusses "Question No. 12: Method for Determining the Maximum Flood Discharge that May Be Expected at a Dam and for Which It Should Be Designed. Selection of Type, Capacity, and General Arrangements of Temporary or Permanent Outlets and Spillways." Kanwar Sain, of the Irrigation and Navigation Commission of India, presents a summary of the 42 papers, which is followed by the complete texts of the papers. In Volume III is discussed "Question No. 15: Concrete for Large Dams." The general reporters are F. M. Lea and H. D. Morgan, both of Great Britain, who summarize the 30 individual papers printed in the volume. Volume IV discusses the "Question No. 14: Silting of Reservoirs and Related Problems." The general reporter is Georges Drouhin, director of Colonization and Irrigation, Algiers. Sixteen papers are summarized and printed in the volume.

Four volume sets may be ordered from the United States Committee on Large Dams, P.O. Box A-A, Boulder City, Nev. The price per set is $48, postage paid, and checks should accompany order and be made payable to Secretary-Treasurer USCOLD.

Gustav Egloff Receives Washington Award

Dr. Gustav Egloff (left) director of research for Universal Oil Products Co., Des Plaines, Ill., receives the Washington Award for 1953 from Dean Ovid W. Eshbach, president of the Western Society of Engineers, at a dinner held in Chicago on February 23. Honored for "distinguished leadership in petroleum research and development, in professional activities and in community services," Dr. Egloff addressed the audience of 500 on the impact of petroleum on our civilization. The award, which was founded in 1916 by John Watson Alvord, is administered by the Western Society of Engineers on recommendation of a commission representing the four Founder Societies.

Executive Committee of Engineering Mechanics Division Charts Its Course

Meeting in Chicago on February 3, Executive Committee and committee chairmen of the ASCE Engineering Mechanics Division chart the course of the Division, the Society's newest Technical Division. Seated, in usual order, are Don Reynolds, assistant to the ASCE Executive Secretary; Nathan M. Newmark, chairman of the Executive Committee; and Douglas McHenry and Harry N. Hill, Executive Committee. Standing, in the same order, are D. C. Drucker, secretary of the Executive Committee; M. P. White, Committee on Structural Dynamics; J. S. McNown, Committee on Fluid Dynamics; Carl Muhlenbruch, Committee on Mechanical Properties of Materials; P. F. Chenea, Committee on Elasticity; Ralph Fadum, Executive Committee; D. H. Pletta, Committee on Experimental Analysis and Analogues; and Bruce G. Johnston, Committee on Plasticity Related to Design.

Scope of California Conference Expanded

The annual California Sections Conference, which met during the San Francisco Convention, voted to incorporate the Arizona, Intermountain, and Hawaii Sections, and to rename it the Pacific Southwest Conference.

Among the resolutions passed by the Conference was one urging that necessary steps be taken to raise Society dues to $27.50 per year for all Members and Associate Members, and to $13.75 for all Junior Members. As a first step toward accomplishing this, written petitions, signed by no less than 200 members from each of the four Zones, must be presented to the Secretary, and as a final step a two-thirds affirmative vote of the members voting to change the Society's Constitution would be required.

The next meeting of the conference will be in Sacramento, April 28–May 1, 1954.

Engineers in Service to Be Notified of Jobs Open

To make sure that engineering graduates now in the Armed Services are kept informed of the pressing need for their services in industry and other work and of ways of obtaining proper placement information when they leave military service, the Engineering Manpower Commission of Engineers Joint Council has initiated a program of notifying the engineer servicemen of job opportunities that arise.

The program calls for mailing to each member of the constituent societies of Engineers Joint Council, known to be in the Armed Forces at the present time, a letter explaining the program and including several wallet-sized cards recommending that they contact the placement bureaus of their alma mater or the Engineering Societies Personnel Service, Inc. Each engineer receiving such a letter will be urged to pass the extra cards along to other engineering graduates they know in the service. Additional cards may be requested from the Engineering Manpower Commission, 29 West 39th Street, New York 18, N.Y.

In announcing the program, which will be advantageous to industry as well as to young engineers, Dr. T. H. Chilton, chairman of the commission, pointed out that industry has been informed of the program and will maintain close liaison with the various placement agencies to assure that material regarding engineering employment will be available to returning veterans. Although the Engineering Societies Personnel Service was set up primarily to serve members of the constituent societies, returning veterans who are non-members are welcome to use the Service which has offices in New York, Chicago, Detroit, and San Francisco.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

The North-South Expressway now under construction in Akron was described at the February 26 meeting of the **Akron Section** by M. D. Wilson, of the Akron City Highway Division. A joint city, state, and federal venture, the expressway is a limited-access freeway designed for twenty years of anticipated traffic. Most striking feature of the project is a viaduct 1,500 ft long, 90 ft wide, and 160 ft high. An engineering committee, established by local civil defense authorities to handle all engineering problems involved in defense, is headed by Section member B. F. Perry.

A "down-to-earth" discussion of typical uses of structural welding was heard at a recent meeting of the **Arizona Section** and Phoenix groups of the other three Founder Societies. The attendance was 150, and the speaker Van Rensselaer P. Saxe, Baltimore consultant. Mr. Saxe expressed the opinion that no material can compete with steel for building because of its superior elasticity, and urged fabricators to restore steel "to structural usage as before the prominence of reinforced concrete."

Latest developments in the field of precast concrete were detailed at the February 17 meeting of the **Buffalo Section** by Dan L. Sutter, technical representative of Anchor Concrete Products, Inc., Buffalo. Mr. Sutter made liberal use of slides to show actual uses and installations of concrete blocks and precast concrete and stresterete slabs.

Two members of the Board—Director Warren Parks, of District 9, and Director C. G. Paulsen, of District 5—attended the January 22 joint meeting of the **Central Ohio Section** and the Ohio State University Student Chapter and spoke briefly on Society affairs. The speaker of the evening, T. J. Kauer, chief engineer of the Ohio Turnpike Commission, outlined the financing of the de luxe highway across the state, and described the various route and traffic surveys made to determine the best location for it. He said that engineering plans are well ahead of schedule, and that contracts for major structures along the route have either been let or soon will be.

New **Cincinnati Section** officers—announced at the February 4 meeting—are Sven E. Sjodhal, president; Lewis G. Hexem, vice-president; and William G. Hamlin, secretary-treasurer. Speaking on "Mixture Design for Asphaltic Concrete," Belman U. Duvall, section chief for the Ohio River Division Laboratories, said that, in the recent war, high wheel loads and tire pressures called for new apparatus and techniques, and described the development and application of the Marshall Test Procedure to fill the need. He also discussed the effect of jet aircraft and rocket-assist operations on pavements.

The **Cleveland Section** is taking part in a series of television programs on vocational guidance sponsored by the Cleveland Technical Societies Council. The program for the February meeting consisted of a talk by Carl Supp, of the J. E. Greiner Co., on turnpike design and construction. Mr. Supp explained the difficulties encountered in developing profiles for the Ohio Turnpike because of strip mine coal seams and pre-glacial valleys filled with silt. Portable seismographic equipment is being used to supplement electric-resistivity equipment in determining sub-soil formations, he said.

New and outgoing officers of San Diego Section, caught by the camera, are (left to right) Secretary George R. Saunders, construction engineer for San Diego Unified School District; Vice-President William J. Bobiach, director of design for the 11th Naval District; outgoing President A. K. Fogg, city engineer for San Diego; incoming President Robert K. Fogg, practicing civil engineer; and Treasurer Harlow Hyde, Jr., civil engineer for the 11th Naval District. For the first time on Local Section record, a father turns over the president's gavel to his son.

Scheduled ASCE Conventions

MIAMI BEACH CONVENTION
Casablanca Hotel
June 17–19,
1953

NEW YORK CONVENTION
Hotel Statler
October 19–23
1953

ATLANTA CONVENTION
Hotel Biltmore
February 15–19, 1954

R. Robinson Rowe Retires as Sacramento Section President

At a formal dinner of the Sacramento Section R. Robinson Rowe (Prof. N. G. Neare to readers of "Civil Engineering") is honored by the Section upon his retirement as president. Mr. Rowe has the unusual distinction of having served two Sections as president, having been president also of the San Diego Section. Shown with him (left) is incoming Section president Walter Schulz. The ladies are (left to right) Mrs. Almeda Reily of Michigan, mother of Mrs. Rowe; Mrs. Eckka Robinson Rowe of San Diego, who was introduced as representing four generations of members in ASCE; Mrs. Schulz; and Mrs. R. Robinson Rowe. The senior Mrs. Rowe is the daughter of Stillman Williams Robinson, M. ASCE, 1884–1910; sister of Erdis G. Robinson, M. ASCE, 1909—; mother of R. Robinson Rowe, M. ASCE, 1927—; and grandmother of Edwin Robinson Rowe, J.M. ASCE, 1952—.

Heard at recent meetings of the Northwest Subsection of the **Florida Section** were Walter C. Knox, resident engineer on the "Jim Woodruff Dam," who explained the plans of the Corps of Engineers for the area, and J. E. McCall, geological engineer for the California Oil Co. The Northwest Subsection meets in Pensacola.

The February dinner meeting of the **Georgia Section** was strictly a business session, with talk centering about the functions of the various committees appointed for 1953 operation of the Section. Col. M. E. Cox, general chairman of the ASCE Atlanta Convention, scheduled for February 1954, reported on the progress being made by his committees.

To avert the "high mortality rate among Junior Members of ASCE," the **Illinois Section** has established a special Committee on Young Engineers. The aim of the committee, headed by J. G. Duba, will be "to create in the young engineers a greater interest in the Society and an appreciation of the responsibilities incumbent on ASCE members for further development of their profession." New Section officers are Frank W. Edwards, president; E. M. Fucik, vice-president; and Henry Miller, treasurer. The roster of recent luncheon meeting speakers includes Henry Miller, Chicago consultant; George Salter, filtration engineer for the City of Chicago; Prof. George Osterberg, of Northwestern University; and C. J. McLean, of the Public Service Company of Northern Illinois.

Discussion of state legislation directly affecting engineers is a regular feature of **Intermountain Section** meetings. On the agenda for study at the February 19 dinner meeting, held in Salt Lake City, were the status of the engineers' registration law, a stream clean-up bill, and a bill proposing to provide representation for the state in all interstate water resources discussions. An illustrated talk on "Soil Mechanics and Its Place in Industry"—given by Warren D. Curtis, of the firm of Dames & Moore—was followed by discussion from the floor.

Civil engineers have not properly discharged their professional duty in their failure to advise the public of the gross deficiencies in their highway system, Ruben N. Bergendoff told members of the **Kansas City Section** in the leading address at the February 10 dinner meeting. Speaking on "Developments in Expressway and Turnpike Planning as They Affect the Kansas City Area," Mr. Bergendoff pointed out that only about 5 percent of total car-operating costs go for the construction and maintenance of street and highway systems. In his opinion, necessary expressways can be financed and constructed if the public is properly advised as to the need for them. Mr. Bergendoff is a member of the Kansas City firm of Howard, Needles, Tammen & Bergendoff.

New officers of the **Kansas Section,** elected at the annual business meeting on January 15, are George L. Epps, president; Frank D. Kinney, vice-president; and Emory Bond, Jr., secretary-treasurer. "Life in Europe" was described by Richard Hrdlicka, of Topeka, in the featured talk.

Heard at recent monthly meetings of the **Los Angeles Section** were George F. Yackey, chief engineer and general manager of the Fallbrook Utilities District, who spoke on "The Fallbrook Situation"; David L. Narver, Jr., project engineer for the AEC at the Eniwetok Proving Grounds, whose topic was "Operation Green House"; and the Rev. Thaddeus H. Kreye, O.F.M., St. Anthony's Seminary, Santa Barbara, who spoke on structural problems involved in the restoration of the historic Santa Barbara Mission.

Portland traffic conditions as they affect the social and economic life of the area were the subject of intensive discussion at the March meeting of the **Maine Section,** held in Portland. Speakers were William B. Getchell, executive secretary of the Maine Turnpike Authority; Roger Creighton, city planning engineer of Portland; Samuel H. Connor, traffic engineer; Vaughan Daggett, assistant chief engineer for the Maine State Highway Commission; and Neal D. MacDowell, district engineer for the U. S. Bureau of Public Roads at Augusta. During the winter well attended luncheon meetings were held in the Augusta area.

Steps being taken to form a District 6 Council of Sections were ratified by the **Maryland Section** at its February 11 dinner meeting, following a report by Theodore Bloecher, Jr., Section representative to the organizing group. In the address of the evening, Clarence D. Long, Jr., professor of economics and research at the Johns Hopkins University, spoke on the subject, "The British Look at Labor Productivity." His talk was based on recent reports made by teams of British industrialists and workmen after a study of United States production methods to determine the reason for the greater output per worker in this country. Our productivity is attributed, in part, "to dimensional standardization; better planning; closer and more human supervision of work."

A **Miami Section** committee has been reviewing proposed charter revisions for the City of Miami at the request of the Citizens Charter Revision Committee. The problems confronting the Miami Transit Co., particularly traffic congestion in the downtown area, were described at the Section's February meeting by R. D. Freeman, senior vice-president of the company. His suggestions for alleviating the congestion include the establishment of large parking areas 15 to 20 blocks from the main business district, with an inexpensive bus shuttle service between the two.

The relation of research to design in the field of reinforced concrete was explored by C. A. Willson, research engineer for the American Iron and Steel Institute, at the February 25 meeting of the **Nebraska Section,** held at the University of Nebraska. Mr. Willson showed why and how reinforced concrete research has provided information for the revision of standards in the field and discussed the comprehensive bond tests that paved the way for the development of improved types of deformed reinforcing bars.

Members of Hungry Horse Branch of Montana Section, associated with U.S. Bureau of Reclamation and General-Shea-Morrison Co., in construction of Hungry Horse Dam, are (seated, left to right) Curtis Olds, Lyle Phinney, E. F. Gehri, J. D. Officer, and E. J. Simpson, construction superintendent. Shown standing are A. J. Johannesen, W. F. King, J. J. Peebles, R. E. Campbell, and C. F. Palmetier. Completed project is visible in background.

The **Northeastern Section** is concentrating on an all-out drive to increase its membership, especially among Junior Members. For their March dinner meeting, members heard John D. M. Luttman-Johnson, senior engineer for Fay, Spofford and Thorndike and consultant to the International Bank for Reconstruction and Development, give an illustrated talk on Ceylon's six-year engineering-economic development program.

Highway relocation work involved in a recent $46,000,000 dam-power plant project constructed by Morrison-Knudsen on the Clark Fork River between Idaho and Montana was described at the March 2 meeting of the **Northwestern Section** by H. S. Claybaugh, division engineer for the Northwestern Division of the Armco Drainage and Metal Products Co. Mr. Claybaugh dealt, particularly, with the installation of twin lines of corrugated metal pipe equalizers with 100-ft cover. The Section is pushing plans for the joint meeting of the International Association of Hydraulic Research and the Hydraulics Division of the Society, to which it will be host early in September.

Students were to the fore at the February meeting of the **Oregon Section**, with ASCE Director Glenn W. Holcomb describing intensified Society interest in the Chapters and a student paper competition the principal feature of the program. Robert Wendlandt, speaking on "Structural Factors of Safety," was awarded first prize in the competition. Former ASCE Vice-President John W. Cunningham expressed his disapproval of the recently adopted plan of rotation for directorship of District 12 of the Pacific Northwest Conference, saying that rotation of the directorship on the basis of membership percentage would give the Section a turn about every twelve years instead of every twenty-one years as under the latest plan. He urged further study of the situation.

A talk on money—what has happened to it in recent years, what may happen to it in the future, and what we can do to protect the purchasing power of the dollar—was the drawing card for the **Philadelphia Section's** February meeting. The speaker was Stanley L. Phraner, noted economist and statistician, and the subject of his address, "Your Money Is What You Make It."

Fiberglas and its uses in thermal and acoustical insulation, air infiltration, and reinforced structural parts were discussed at the February meeting of the **Providence Section** by F. A. Mennerich, manager of process developing for the Owens-Corning Fiberglas Corp. Mr. Mennerich was pinch-hitting for J. K. Park, also of Owens-Corning.

Engineering legislation currently under consideration by the Washington State Legislature was summarized for **Tacoma Section** members by E. C. Dohm and Ronald Knapp at the Section's February meeting. The Section went on record as favoring passage of pending legislation, including a bill pertaining to earthquake-proof building design and two bills affecting the registration of architects. R. G. Tyler, professor of sanitary engineering at the University of Washington, was guest speaker, with a talk on "Engineering Development of a Municipal Sewer System."

Paul Krause, sales representative for the U.S. Steel Supply Division, described the activities of his organization at the February 4 meeting of the **Toledo Section** and showed films illustrating the wide utility of steel.

Problems overcome in reaching the site of the new iron-ore deposits in the wilds of Labrador, notably building a 300-mile railroad to the site, were discussed at the February 10 meeting of the **Wisconsin Section** by E. T. Cross, vice-president in charge of sales and railroad construction for the Armco Drainage and Metal Products Co.

Coming Events

Central Ohio—Meeting in Columbus, on April 16.

Cleveland—Dinner meeting at the Cleveland Engineering Society on April 17 at 6:30 p.m.

District of Columbia—Meeting at the Cosmos Club auditorium, Washington, D.C., April 14. Meetings of the Junior Forum on the fourth Wednesday of each month.

Lehigh Valley—Inspection trip of Central Railroads' Allentown freight yards leaving from the Bethlehem station on April 14 at 4:45 p.m. Dinner at Howard Johnson's on Route 22 in Allentown at 7 p.m.

Los Angeles—The Junior Forum will hold its annual spring banquet at the Mona Lisa restaurant, 3343 Wilshire Boulevard, Los Angeles, April 24, at 6 p.m.—dinner will be served promptly at 7 p.m. Luncheon meetings of the Forum at the Hotel Clark Coffee Shop every Friday at 12 noon.

Metropolitan—Meeting in the auditorium of the Engineering Societies Building, 33 West 39th St., New York, N.Y., April 15 at 7 p.m. The Junior Branch meets in the ASCE Board Room at the same address, April 22 at 7:30 p.m.

Mid-South—Spring meeting at the Hotel Lafayette, Little Rock, Ark., April 9–11. Highlights of the meeting will include an address by President Walter L. Huber. Early Arrivals Reception, April 9 at 7 p.m.; registration, technical program, luncheon and banquet, April 10; and business session and field trip to Granite Mountain quarry of the Big Rock Stone and Material Co., April 11.

New Mexico—Joint meeting with the Student Chapters of Texas Technological College, Texas Western, University of New Mexico and New Mexico A & M., April 24 and 25, at New Mexico State College.

Northeastern—Joint dinner and meeting with the Boston Society of Civil Engineers at Northeastern University, April 15.

Oklahoma—Spring meeting in Oklahoma City, April 25.

Philadelphia—Joint meeting with the Trenton Engineers' Club at the Engineers' Club on April 14, at 7:30 p.m. Dinner meeting of the Central Pennsylvania Subsection at the Harrisburg Civic Club, May 13, at 6:30 p.m.

Pittsburgh—Joint dinner and meeting with the Society of American Military Engineers, April 14 at 6:30 p.m.

Providence—Meetings are held in the auditorium of the Providence Engineering Society on the second Thursday of each month at 8 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

West Virginia—Spring meeting at Clarksburg, W. Va., May 1. The all-day program includes a field trip to inspect operations of a coal auger mining machine; showing of two films—"Adam to Atom" and "Road Test One—Maryland"; and dinner with the Student Chapter of West Virginia University.

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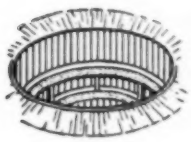
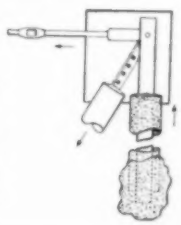
PROBLEM: To protect the upper section of steel H-piles from corrosion. WESTERN devised an economical method* of scouring the steel and encasing the upper 10 to 30 ft. of H-section in concrete after it has been driven as a pile. Encasing concrete is placed in the dry.



PROBLEM: To assure safety and facilitate work inside circular cofferdams. WESTERN eliminates all the usual cross bracing and "spiders," by use of reinforced concrete ring wales. The cofferdam is entirely open for operation of equipment and for building of the permanent structure. In one case a floating hydraulic dredge was placed inside the cofferdam to speed the excavating.

PROBLEM: To provide a bulkhead of adequate strength where proximity of structures or sliding ground makes the usual buried anchorage impractical. For use with steel sheet pile bulkheads, WESTERN introduced a rigid A-Frame tie-back utilizing a vertical tension resisting Pedestal Pile in combination with a batter pipe or H-Beam compression pile. Pedestal Piles have been tested to 160 tons tension resistance.



PROBLEM: To drive a large tip, cast-in-place pile longer than the leads. WESTERN is now driving its standard Buttoff-Bottom Pile* to depths of 100 ft. or more with 90 ft. leads, thus preserving stability and mobility of equipment. An auxiliary section is added to the drive casing and the large button point (227 sq. in. compared with 50 sq. in. for an 8 in. pile tip) is driven to the deep bearing stratum.

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NEWS BRIEFS . . .

India Dedicates Bokaro Steam Power Plant

American engineering skill and efficiency were praised by Prime Minister Nehru, on February 21, at dedication ceremonies for the huge new Bokaro Steam Power Plant, first unit in India's $140,000,000 multi-purpose power system modeled after the TVA. Built at a cost of $35,000,000, the Bokaro Power Station is the first major high-pressure steam plant in the Far East as well as the largest in Asia. It is linked to a series of dams in a gigantic irrigation, power and flood control project covering the 330-mile-long Damodar Valley in eastern India. The Kuljian Corp., of Philadelphia, designed and constructed the Bokaro Plant.

When completed, the program will end disastrous floods in the thickly populated valley, supply water from eight major storage dams for irrigation of more than a million acres, and furnish nearly 500,000 kw of hydro and steam electrical power for eastern India's industries. The Indian government, the World Bank, and a group of American and Indian engineers are cooperating in the development, which was authorized by the Indian parliament in 1948.

Contract Awarded for Addition to Alcoa Plant

A 13,200-ton horizontal extrusion press is being erected for the Aluminum Company of America at its Lafayette, Ind., plant, following award of an Alcoa contract to F. H. McGraw & Company, engineers and constructors of Hartford, Conn. The new press, which was built in Germany, is being installed as part of the Air Force's heavy press program. It will be more than twice as powerful as any extrusion press now in operation, producing extrusions nearly four times the weight of those currently available as well as extruded shapes of greater width. In the wing panel of an airplane, this will mean a stronger skin with less weight and riveting.

When the press starts operating next summer, the government will have first call on all production due to a lease arrangement between Alcoa and the U.S. Air Force. Later the press will be used to make aluminum pipe for the petroleum industry, curtain walls for modern buildings, and strong alloy shapes for various industries.

Contracts Let for Construction of Mackinac Straits Bridge

Award of contracts for the construction of a 3,800-ft suspension span across the Mackinac Straits is announced by the State of Michigan's Mackinac Bridge Authority through D. B. Steinman, M. ASCE, consultant to the Authority and designer of the crossing. The contract for the construction of the substructure has been awarded to Merritt-Chapman & Scott for $24,525,600 and for the superstructure to the American Bridge Co. for $41,544,563. Total cost of the project will be $96,000,000.

The bridge, which will be the second longest suspension span in the world, will link the northern and southern peninsulas of Michigan and provide an important link from southern Michigan to the vital Sault Ste Marie Locks. Transportation across the straits is now provided by five ferry lines, which make the crossing in 53 min. The highway crossing should take 10 min.

The four-lane structure has been in the dream stage for a quarter of a century, but it was not until 1952 that authority was granted to finance the project with revenue bonds. The bonds will be repaid over a 25-year period out of tolls—$2 for each automobile and driver and 25 cents for each passenger. Prentiss M. Brown, chairman of the Mackinac Bridge Authority, estimates interest charges on the structure at from 3.75 to 4 percent. The structure is scheduled to be opened to traffic November 1, 1956.

Merritt-Chapman & Scott, contractor for the substructure, has recently undergone a shift in its top echelon, with Morris B. Wolfson appointed president and Ralph DeSimone president in charge of the company's foreign work.

Projected four-lane suspension bridge across Straits of Mackinac is shown here in artist's rendering. With distance between towers 400 ft less than in Golden Gate Bridge and 300 ft greater than in George Washington Bridge, structure will be second longest suspension span in the world. Map indicates exact location of span, which will connect Mackinaw City and St. Ignace.

New Contract to Expand Lake Charles Air Base

Award to the Merritt-Chapman & Scott Corp. of a $859,968 low-bid contract for construction of aviation fuel storage and distribution facilities at the Lake Charles Air Force Base, Lake Charles, La., is announced by the Galveston (Tex.) District Office of the Corps of Engineers. The work will entail construction of underground storage tanks and transmission lines and hydrant systems to be used in fueling and defueling planes.

Impact Resistance of Concrete Is Studied

Although considerable data have been collected on the strength of various types of concrete under static conditions, relatively little is known about their resistance to impact. Since such information is of vital importance in designing structures to withstand explosive blasts and earthquakes, the National Bureau of Standards is conducting an extensive study of the properties of concrete under impact in cooperation with the Navy Bureau of Yards and Docks. In results obtained thus far, the dynamic compressive strength of concrete was found to be up to 84 percent higher than the static strength, and the modulus of elasticity up to 47 percent greater.

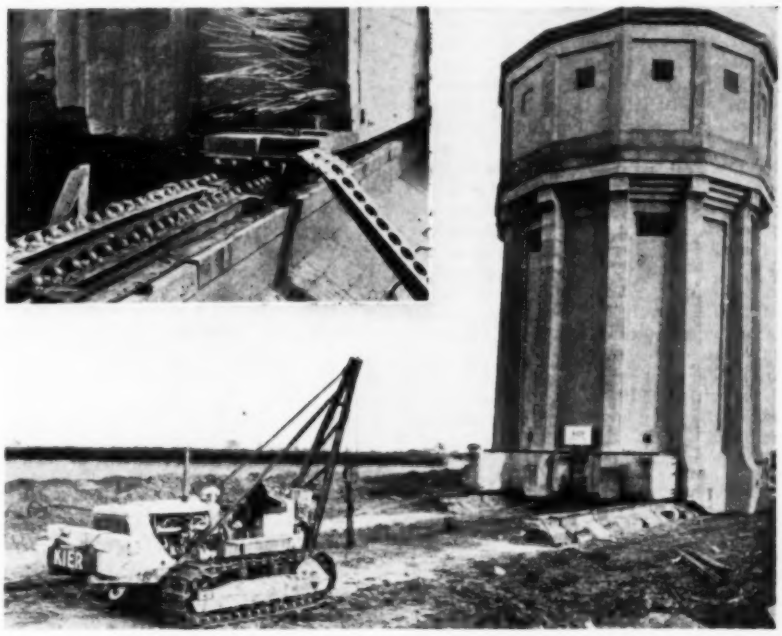
The significant increases in compressive strength, elastic moduli, and ability to absorb strain energy under impact loading are of importance to the designer. Further studies of the effect of impact on concrete in flexure are in progress to enable designers to take account of the potential saving of material in structures to be erected where they may be subjected to earthquakes, bomb blasts, or similar impact loading.

The testing methods used and other details are given in Building Research Summary Report 88, which may be obtained from the National Bureau of Standards, U.S. Department of Commerce, Washington 25, D.C.

Surveying Instruments Co. Moves Its Headquarters

The Henry Wild Surveying Instruments Supply Co. of America, Inc., announces the removal of its executive department, sales department, and repair facilities to new and expanded quarters at Main and Covert Streets in Port Washington, N. Y. Wild instruments are Swiss designed and engineered for precision performance. The line includes transits, theodolites, levels for surveying and optical tooling, geodetic accessories, topographic instruments, photogrammetric equipment and aerial cameras.

Heavy Equipment Solves British Moving Problem



Here the tractor is shown towing the 80-ft-high water tower along its specially prepared track. By means of a block and tackle, the five-ton pull of the D7 exerts a pull of about 50 tons on the 1,900-ton tower. The hoist attachment on the tractor was used to move the concrete blocks, utilized in the track foundation, from the rear to the front of the tower, after the tower had covered about 50 ft. Standard bullhead railway line and $2^1/_2$-in. steel balls make up the four ball races upon which the tower was towed, as shown in the inset. The track was set on concrete blocks, which were 6 ft wide at the bottom and 2 ft wide at the top. Prestressing wires for the beams are clearly visible. Photos courtesy Caterpillar Tractor Co.

A solution to the problem of moving a 1,900-ton water tower in England was found in a Caterpillar D7 Diesel Tractor, which was utilized to pull the 80-ft-high concrete structure 300 yd over specially constructed track. E. Ingerslev, of J. L. Kier & Co., Ltd., was confronted with the job, when it was decided that the tower, located in the Bedford Rural District Council area, would have to be moved to a new location or demolished. Mr. Ingerslev's plan was to lay a concrete-based rail track, on which a cradle bearing the tower could be pulled. The D7 was to be equipped with a ten-to-one block-and-tackle reduction that would enable its five-ton pull to exert a 50-ton pull. It was estimated that the project would cost about half as much as the cost of building a new tower at the new location.

The track consisted of continuous ball races made up of ordinary bullhead-section railway lines laid on their sides, one above the other. Between them were the bearings—about 800 steel balls $2^1/_2$ in. in dia. The ball races were arranged in pairs, each supported by a line of precast concrete blocks 6 ft wide at the bottom and 2 ft wide at the top. These blocks spread the load over the full width of two concrete roads leading from the tower to the new site. The roads consisted of 4-in. concrete on a hard core base rolled into the clay subsoil that had previously been cleared and leveled by the Caterpillar D7 tractor and dozer combination.

The first section of track was built up around and through the base of the tower, the 2-ft concrete walls being cut to allow the rails to pass through. A concrete cradle, carrying the tower as it was hauled along the track, was made up of a series of prestressed concrete beams, each of which was 6 by 2 ft.

Where the beams went through the tower structure, holes for the prestressed cable were bored so that the tower itself formed part of the cradle. When the cradle was finished and lying securely on the track, eight of the tower's twelve supporting columns and the panel walls were cut away by blasting. This left the tower supported by only four columns, which were gradually cut away until the tower settled on the track.

In towing the tower, the D7 pulled through the block and tackle so that for each 10 ft the tower moved 1 ft. The track was arranged so that the tower could be moved about 50 ft in one haul. With crews working continuously, regardless of weather, the tower was placed on its new foundation just four weeks after it was moved from its original site.

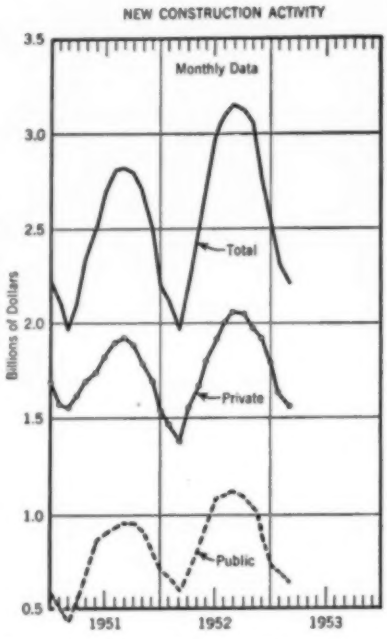
February Construction at Record High for the Month

Expenditures for new construction declined less than seasonally in February to $2.2 billion, and were at a record high for the month, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the U.S. Department of Commerce.

Private spending on commercial and most other types of non-residential building continued strong for the time of year, reflecting to some extent a backlog of projects put under construction since relaxation of credit and materials controls in the latter half of 1952. Because of the winter drop in housing starts, expenditures for work put in place on private non-farm housing declined 8 percent from the January total to $675 million. However, additions and alterations to existing housing increased 5 percent to $67 million.

Most types of public construction in February showed the decline usually expected for the month, reducing total public outlays about 9 percent from January to $632 million.

Expenditures for all new construction during the first two months of this year were nearly 6 percent above last year's total for the same months, and with November and December taken into account also, new construction activity was at record levels for the winter of 1952–1953. Thus far this year, most major types of construction showed dollar increases over January and February 1952. However, hospital building (private and public) is down substantially because of the tapering off of the Public Health and Veterans Administration construction programs. Also, expenditures for private industrial building were less than in January and February of last year when private plant expansion was at unusually high levels. The drop in expenditures for public housing over the year reflects the reduced statutory limit on the number of federally subsidized units that may be started this fiscal year.



Less than seasonal decline in February construction keeps activity at record high for the month, as shown by Department of Commerce curves.

Wide Range of Concrete Uses Studied at ACI Meeting

Such relatively new uses for concrete as a radiation shield, together with all the traditional uses, were studied at the 49th annual convention of the American Concrete Institute, held at the Statler Hotel in Boston, February 17–19. "The advent of the nuclear energy industry presents considerable demands on the concrete technologist," said Edwin J. Callan, chief of the Thermal Research Section, Concrete Research Division, Waterways Experiment Station, in a leading paper. Concrete, he reported, is an effective, versatile, and economical material for permanent shielding installation. It possesses good compromise thickness requirements for both neutron and gamma-ray attenuation, sufficient mechanical strength, low maintenance, and reasonable cost. While ordinary concrete in sufficient thickness will provide satisfactory shielding, Mr. Callan said, heavy concrete made from special aggregates with a generally higher unit cost is often preferable due to smaller thickness requirements. Other papers on the same program covered use of fly ash in concrete, "accidental" air in concrete, freezing and thawing tests on concrete, and shotcreting.

Henry L. Kennedy accepts presidency of ACI for 1953. Retiring President A. T. Golbeck is shown seated.

In a symposium on projects where thin-shell pre-cast panels have been used to advantage, Charles Zollman, A.M. ASCE, of the Vacuum Concrete Corp., Philadelphia, described the plant and job planning for producing large numbers of identical pre-cast concrete roof elements. He said that 4,000,000 sq ft of thin-shell rib panels were used for roof framing in seventeen warehouses, each 200 by 1,000 ft. Molds made of concrete were used in the casting operations. So effective was the prior planning and the setting up and operation of the casting yard that the only important interruption to production was when construction of cast-in-place rigid frames could not keep up to the supply of panels.

Another session brought out the fact that development of the jet aircraft engine is changing not only the future of aviation but also affecting many tangential fields including the concrete industry. Aircraft engines require testing during development and production. Such tests are normally conducted within concrete structures that have an exhaust stack for attenuating the engine roar and directing exhaust gases skyward. Since jet engines can raise the temperature within such structures from room temperature to 1200 F in eight seconds, special refractory concretes are needed to withstand the deteriorating effects of heat, temperature, shock, and cycling. The problems involved in constructing such structures were reported in detail by Herman G. Protze, consulting technologist on concrete and construction materials, Boston.

Many ASCE members were among those honored for papers and other contributions to the field of concrete. Franklin R. McMillan, consulting engineer of Asheville, N.C., received the Alfred E. Lindau Award "in recognition of his contributions to reinforced concrete design practice." Charles H. Scholer, professor and head of the Department of Applied Mechanics at Kansas State College, was awarded the Wason Medal, with Gerald M. Smith, for "noteworthy research" reported in "Use of Chicago Fly Ash in Reducing Cement-Aggregate Reaction" in the February 1952 *ACI Journal*.

Charles S. Whitney and Boyd G. Anderson, partner and chief designing engineer, respectively, in Ammann and Whitney, New York and Milwaukee, and Mario G. Salvadori, consultant to the firm and professor of civil engineering at Columbia University, received the Wason Medal for the "most meritorious paper" of the volume year. Entitled "Comprehensive Numerical Method for the Analysis of Earthquake-Resistant Structures," the winning paper appeared in the September 1951 issue of the *ACI Journal*.

At the conclusion of the three-day program, Henry L. Kennedy, M. ASCE, manager of the Cement Division, Dewey & Almy Chemical Co., was inducted into the presidency of the ACI, succeeding A. T. Golbeck, M. ASCE. Charles S. Whitney, M. ASCE, is new vice-president for a two-year term, and C. H. Scholer, M. ASCE, is beginning the second year of his two-year term as vice-president. Mr. Kennedy was convention chairman.

Contract Given for Gavins Point Dam

Award of a $17,525,046 contract for the second phase of construction at Gavins Point Dam, located on the South Dakota-Nebraska border four miles upstream from Yankton, is announced by the Army Corps of Engineers. Bid as a joint venture, the work will be done by the Western Contracting Corp., Sioux City, Iowa; the Massman Construction Co., Kansas City, Mo.; and the J. A. Jones Construction Co., Charlotte, N.C.

The present contract includes building the powerhouse substructure, the spillway, and stage two earthwork, which will complete the embankment. When the contract is completed in November 1955, the dam will be able to perform its primary function as a re-regulating reservoir for Fort Randall Dam now under construction 75 miles upstream. Construction of the project started last spring, and a portion of the dam's foundation, most of the excavation for the powerhouse, and a paved access road have been built so far.

F. V. du Pont Appointed Public Roads Commissioner

Appointment of Francis V. du Pont, of Wilmington, Del., as Commissioner of the Bureau of Public Roads is announced by the Secretary of Commerce. Recognized as one of the foremost administrators of public highways in the country, Mr. du Pont was a member of the Delaware State Highway Department from 1922 to 1949—for 23 years as chairman. During his tenure as chairman, the dual-highway system was inaugurated and the Governor Printz Boulevard and other important roadways constructed. He directed an extensive highway beautification program, and was responsible for directing the engineering, financing, and commencement of construction of the Delaware Memorial Bridge.

Jamaica Bauxite Swells U.S. Aluminum Supply

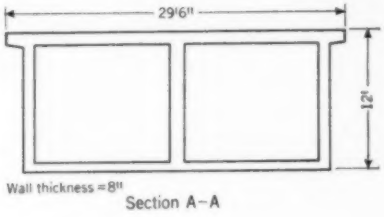
Opening of its $12,000,000 bauxite mining operations in Jamaica, B.W.I., and the first 10,000-ton shipment of this aluminum ore, are announced by the Kaiser Aluminum & Chemical Corp. Operated by the Kaiser Bauxite Co., a subsidiary of the corporation, the new bauxite properties will have an annual capacity of approximately 2,000,000 tons. The primary facilities and initial mining operations are located in the southwest corner of St. Elizabeth Parish. The bauxite is open-pit mined and hauled in train-load lots by diesel locomotives over 13 miles of private standard-gauge railroad to ore-handling, drying, and storage facilities at Port Kaiser. A conveyor belt system automatically loads the ore ships anchored at a pier 995 ft out from shore where there is sufficient depth of water to handle all sizes of ocean-going vessels.

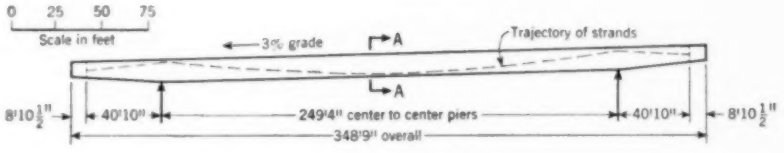
The shipping haul from Jamaica to the company's plant dock at Baton Rouge is approximately 1,100 miles, cutting 1,500 miles off the distance previously required to transport ore purchased in South America. The new development is part of the company's current $200,000,000 privately financed expansion program to increase primary aluminum output to more than 800,000 lb a year and boost production of fabricated aluminum products.

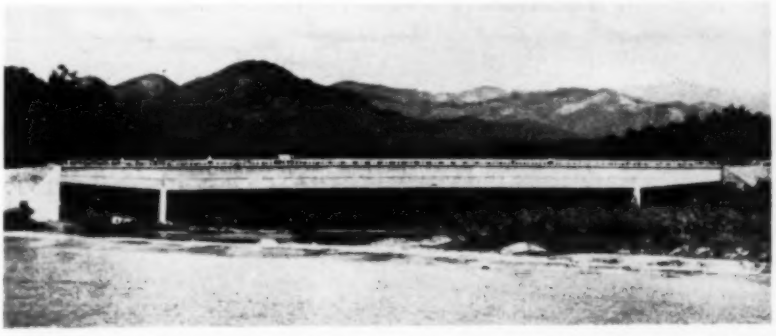
Technical Film Available To Engineering Groups

The Dravo Corporation, Pittsburgh, has completed a new 30-min, 16-mm sound film in color, which is available without charge for showing to engineering groups, schools, and colleges. Entitled "Portrait of an Enterprise," the film documents many of the firm's diversified activities with emphasis on engineering of all kinds. Inquiries should be addressed to the Advertising Department of the Dravo Corporation, Neville Island, Pittsburgh 25, Pa.

Cuban Engineers Build 350-Ft Prestressed Box-Girder Bridge







This 350-ft-long prestressed concrete bridge over the Canas River in Cuba is a vital link in the country's new coastal highway from Cienfuego to Trinidad. Located about ten miles from Trinidad, the structure was designed by Cuban engineers under the direction of Luis Saenz, chief of the Structural Section, Comision de Fomento Nacional, Republic of Cuba. It is post-tensioned by 112 galvanized prestressed strands 1 in. in dia with prestressed fittings attached. As indicated on the sketch, the bridge consists of two hollow boxes for the full length of the main span. At 30-ft intervals concrete diaphragms across the boxes support cast-iron saddles that deflect the strands into their parabolic curves. The cantilever end spans are solid concrete to provide a large negative moment over the piers, thus reducing the maximum positive moment at the center of the main span. In the end spans the strands were greased and wrapped in sisalcraft paper before the concrete was poured around them. When the concrete had cured, each strand was tensioned simultaneously from each end of the bridge. Strands and tensioning equipment were supplied by the John A. Roebling's Sons Corp., of Trenton, N. J., and placing and tensioning of the strands was supervised by H. Kent Preston, A.M. ASCE, engineer for the Bridge Division, John A. Roebling's Sons Corp.

Wisconsin U. Conducts Tests on Aging Concrete

Dean Morton O. Withey, M. ASCE, of the University of Wisconsin College of Engineering, examines cylindrical concrete specimens that are undergoing aging and curing tests in unique 100-year tests under way on the engineering campus. The concrete cylinders were made by Dean Withey in 1910 when the tests were started. Present plans call for continuing the series of tests on aging and curing strengths of concretes and mortars until the year 2023.

New Facility Aids Making of Alloy Seamless Steel Tubing

A new hot extrusion process for forming high-alloy seamless steel tubing and shapes is being exhibited at the Gary, Ind., plant of the National Tube Division of the United States Steel Corp. With the new facility in operation, the Gary plant can now manufacture seamless tubing from tough stainless steels. High-alloy steels have heretofore resisted such piercing operations, according to John E. Goble, president of the National Tube Division. Using different dies, the same press makes special steel shapes which in the past defied all rolling methods. The output of the press is expected to be about 2,000 tons of tubing and shapes a month, he said.

The process, named "Ugine Sejournet" after its French inventor, utilizes the same principle as pressing toothpaste from a tube. In the present case, the "toothpaste" is a steel slug heated to 2,500 deg to make it plastic. The pressure comes from a 2,500-ton hydraulic press, which forces the steel slug through a die to convert it to tubing. Such heat and pressure are required in the new process that glass, which is rammed into the press ahead of the steel, melts and becomes a lubricant. In addition, a fiberglas "stocking" is fitted to the mandrel, which pierces and shapes the inside of the tube as it travels through the die.

Round steel billets for extruded tubing are supplied by other U.S. Steel mills. Cut to length, they are drilled for use as small mandrels in the extrusion of tubes. Each slug is heated to a final temperature of 2,300 deg, in a barium chloride bath to dissolve furnace scale, and then delivered to a charging table. A sheet of fiberglas wraps itself around the slug as it rolls into position before the press. Each inch of an 8-in. round slug pushed through the die emerges as a length of $2^1/_2$-in. tubing nearly a yard long. The die ram is powered by a 2,000-ton hydraulic cylinder; the mandrel by a 500-ton hydraulic cylinder.

Concrete Pipe Association Has Third Annual Meeting

Mutual problems of the Bureau of Reclamation and manufacturers of concrete agricultural-irrigation pipe were discussed at the third annual convention of the American Concrete Agricultural Pipe Association held in Dallas, Tex., February 24 and 25. Bureau of Reclamation representatives and speakers included Howard G. Curtis, M. ASCE, head of the Canals and Pipelines Section; Frank E. Rippon, assistant chief of the Canals Branch; and Lewis H. Tuthill, concrete engineer for the Bureau. Mr. Tuthill's paper dealt with the Bureau's findings and experience in methods of curing and backfilling concrete pipe and the use of calcium chloride with the cement in winter production.

In the election of 1953 officers for the American Concrete Agricultural Pipe Association, J. W. Porter, A.M. ASCE, of Dallas, was reelected president for a second term; R. W. Liston was elected vice-president; and G. F. Lillie and W. B. Freeman, M. ASCE, of Denver, were reelected secretary and treasurer, respectively. Howard F. Peckworth, M. ASCE, is managing director.

Missouri Municipality Builds New Sewerage Project

Typical of many municipal pollution-abatement programs under way throughout the country is this $1,000,000 sanitary sewerage project under construction at Independence, Mo. Aerial view shows treatment plant, taken at an early stage of construction, two clarifiers, trickling filter, and digester and control building at right. Not shown are two pumping stations. Wrought iron was specified for all piping. Consulting engineer on the project is Charles A. Haskins, M. ASCE, Kansas City, and the contractor is Lippert Brothers, Inc., Oklahoma City, Okla.

AWWA Elects New Officers for 1953

New officers for the American Water Works Association—nominated by the Board of Directors at its 1953 annual meeting and confirmed by the membership—are Morrison B. Cunningham, president, and Dale L. Maffitt, vice-president. William W. Brush, M. ASCE, continues as treasurer. The new slate will be inducted into office at the close of the 1953 annual meeting of the AWWA, to be held in Grand Rapids, Mich., May 10–15.

Award of honorary membership in the AWWA will be made during the Grand Rapids meeting to Wendell Richard LaDue, chief engineer and superintendent, Bureau of Water and Sewerage, Akron, Ohio, and Reeves Newsom, village manager of Scarsdale, N.Y. Both are members of ASCE.

Franz Dischinger, Noted German Engineer, Dies

Structural engineers will be concerned to hear of the death of Franz Dischinger, distinguished German engineer and authority on reinforced concrete and thin-shell cylindrical construction, which took place in Berlin on January 9. He was 65. A graduate of the Karlsruhe Institute of Technology and officer in World War I, Professor Dischinger was for some years connected with Dyckerhoff & Widmann, widely known for its pioneer work in reinforced concrete. He left the company to become professor of reinforced concrete construction at the University of Berlin. The recently published ASCE Manual on shell roof design (No. 31) refers to a number of Professor Dischinger's papers. He is also widely known for his research on the buckling stability and deformation of concrete arches and on arch deformation, both elastic and inelastic. His more recent studies dealt with reinforced concrete construction, the design of high dams, and suspension bridge design.

Franz Dischinger

1952 Urban Building Valued at $9 Billion

City building construction in the United States, as measured by building permits issued and federal construction contracts awarded, was valued at $8.9 billion in 1952—about the same as in 1951 but 15 percent under the 1950 record total of $10.5 billion, according to the U.S. Labor Department's Bureau of Labor Statistics. The report covers cities with a population of 2,500 or more in 1940.

Residential construction in these cities, valued at $5.1 billion, was up slightly from 1951 because of gains in the number of one- and two-family houses authorized and because of the increase in permit valuations for hotels. Non-residential building was down by 7 percent to $2.6 billion, largely because of a lower total valuation for urban hospital construction and an almost country-wide drop in factory building within cities. About 617,000 new dwelling units were authorized for construction in urban areas during 1952—an increase of about 3 percent from 1951. The gain was entirely in one- and two-family housing and occurred mostly in cities with a population of 25,000 or less.

Regionally, urban building declined during 1952 in the South and East, but rose in the West North Central States and in the Far West. The sharpest drop (14 percent) occurred in New England, and the greatest gain (14 percent) in the Pacific region. California, with city building valuation totaling $1.3 billion, outstripped all other states in urban building in 1952. The second and third ranking states were Texas and New York, and the top-ranking cities were Los Angeles, New York, Chicago, Detroit, and Philadelphia. Part of the rise in city building construction in the West in recent years is attributed to increasing urbanization, with many cities annexing large adjacent areas that are thereby brought under the building-permit-issuing system.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"That cube problem was a sweet one," announced Joe Kerr. "I mean, I did it with cube sugar and the answer is 10."

"You mean," explained Professor Neare, "that you sawed a 6-in. cube into ten modular blocks and reassembled them in three smaller cubes."

"Eleven, at least," began Cal Klater. "Joe must have. . ."

"Wait your turn," shouted Joe. "Ten I said and ten I mean. Since 216 = 125 + 64 + 27, the sides of the three smaller cubes are 5, 4 and 3, respectively. I tried to work out the division into blocks while on the train going to the Nob Hill Convention, but my isometrics kept turning inside out. So when I found a box of cocktail sugar in the back room of the Capital Headquarters at Room 208, I bought some scotch tape and made models of the blocks.

"Here's a sketch of the dissection (Fig. 1). After taking out the 5-in. cube in one piece, the remaining shell is only an inch thick, and the rest of the division is nearly planar. The gimmicks are the elbow blocks, numbered 9 and 10, and the reentrant trihedral block, numbered 2. If Cal doesn't believe me, Professor, I'll let him play with my scotch-tight sugar models."

"Oh, I believe Joe," replied Cal, "but, as I started to say, Joe must have worked the problem by synthesis instead of analysis. Room 208 had practically everything, but after all, it didn't have the Chopsmith that Kenesaw Q. Bletz got for Xmas. And unless Ken has some new didoes in his dadoes, he can't saw a reentrant trihedral. My sketch (Fig. 2) shows a dissection with ordinary saw cuts into 11 blocks that will make the cubelets."

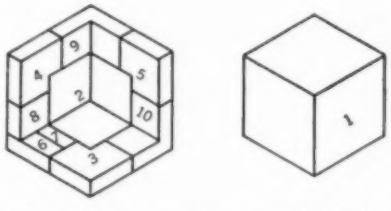


FIG. 1. Only ten pieces are needed if the first is a 5-in. cube; pieces 2–6 make the 4-in. cube.

"Well," temporized the Professor, "I'm going to be neutral and accept both solutions; each is a nice demonstration of the identity $3^3 + 4^3 + 5^3 = 6^3$. How about my other question: would the same number of pieces be required for a 9-in. block?"

"Yup," answer Joe. "Just use 4.5, 6 and 7.5-in. cubelets."

"Nope," countered Cal. "If the 1-in. cube is still the modular unit, we have to divide to the identity $1^3 + 6^3 + 8^3 = 9^3$. The answer is 12 blocks, by synthesis or analysis."

"I think so, too," said the Professor, "but I haven't proved it. Now that you have been introduced to cubism, I am going to introduce Kenesaw's brother, Fortescue Bletz, as Guest Professor to give you another lesson."

"Cubes have been my hobby," responded Professor Bletz, "since I saw the magnificent

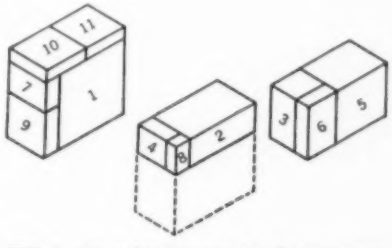


FIG. 2. For ordinary saw cuts, eleven pieces are needed; pieces 1–4, 5–8, and 9–11 make the three small cubes.

cages of the Cuban Zoo. In its aviary, the wrens are displayed in four cubical cages adjoining one another in a straight row, three being nesting cages for different species and the fourth, aggregating the volume of the other three, being a display cage for all species when not nesting. There is a similar set of cages for hawks, and it is remarkable that the side of each of the hawk-nest cages is the sum of the sides of two adjoining wren cages, all dimensions being integers. How small can the smallest cage be?"

[*Joe and Cal was or were: Flo Ridan (Charles G. Edson), Richard Jenney, Sauer Doe (Marvin Larson), Robert Cummings and Edwin A. Verner. Guest Professor Fortescue Bletz is Walter L. Steinfatt.*]

DECEASED

A. O. Ridgway, Former ASCE Director, Dies

Arthur Osbourne Ridgway (M. '11), age 82, retired chief engineer of the Denver & Rio Grande Railway and noted railroad historian and author, died in Denver, Colo., on January 18. Entering the employ of the Denver & Rio Grande in 1892 as a draftsman, Mr. Ridgway had been chief engineer of the line for 26 years at the time of his retirement in 1948. Mr. Ridgway was active in the Society and the Colorado Section, serving as ASCE Director from 1924 to 1926. The accompanying photo was taken during his term as Director. He was a graduate of the University of Kansas.

A. O. Ridgway

Harvey Chester Abrams (J.M. '50), age 29, field operator with the Cities Services Oil Co., at Fort Worth, Tex., died on December 18, as the result of an automobile accident. Mr. Abrams had been connected with the Cities Service Oil Co. since 1950 when he graduated from the Oklahoma Institute of Technology at Oklahoma A & M College, with the B. S. degree.

Charles Frederick Capes (M. '45), age 61, road supervisor for Boulder County, Colorado, died at Boulder, on January 30. Mr. Capes was previously employed in the Denver office of the U.S. Bureau of Public Roads for 36 years, retiring in June 1952 to accept the position of Boulder County road supervisor.

Herbert Rentoul Clarke (M. '47), age 70, retired chief engineer of the Chicago, Burlington & Quincy Railroad and its subsidiary lines, died at his home in La Grange, Ill., on February 18. A graduate of Monmouth College, Mr. Clarke entered the Burlington service as a rodman in 1907, and advanced to chief engineer in 1943. He retired January 1, 1953.

Arnold Alvin Clausen (A.M. '27), age 62 commander, U.S.N.R. (retired), and until recently a resident of Palo Alto, Calif., died in Phoenix, Ariz., on January 31. For many years Mr. Clausen served as a bridge engineer with the U.S. Bureau of Public Roads at San Francisco. He was an alumnus of Oregon State College and a veteran of both world wars.

Henry William Corp (M. '29), age 66, since 1946 civil engineer for the Pampanga Sugar Mills, Manila, P.I., died on November 17, 1951, while held in captivity by guerillas. Earlier, Mr. Corp had been with the Manila Railroad Company for almost 20 years, serving as chief engineer for a period. He was a graduate of Brown University.

Ernest Couloheras (A.M. '47), age 46, commander, U.S.N., died in Naples, Italy, on January 21. For 20 years prior to his recall to active duty in 1952, Commander Couloheras was a civil engineer with the Board of Levee Commissioners at New Orleans, last holding the position of assistant chief engineer. Commander Couloheras was an alumnus of Tulane University.

George Davis Crow (M. '49), age 64, resident engineer on airport construction for Thomas B. Bourne Associates, Inc., of Washington, D.C., died at Houston, Tex., on December 30. Mr. Crow had been in private practice at Henderson and Richmond, Tex., for eleven years and was connected with several Texas firms including the Austin Co., and the Blucher Engineering Co. He was a graduate of the University of Texas.

Warren Clough Estes (A.M. '48), age 37, president and founder in 1947 of the E. & T. Construction Co., Inc., of Los Angeles, Calif., died on June 18. A graduate of the University of Nevada, Mr. Estes had worked for the Bechtel-McCone-Parsons Corp., and served in the last war.

John Warren Fortenbaugh (A.M. '21), age 68, sanitary engineer for the Erie County Penitentiary, and the Erie County Home & Infirmary, died in Buffalo, N.Y., on December 20. Mr. Fortenbaugh had been associated with the Pennsylvania Health Department and the Kaustine Co., Inc., of Buffalo for twelve years each. He was an alumnus of Pennsylvania State College.

Charles Henry Fowler (A.M. '23), age 60, sales engineer for the H. K. Ferguson Co., of Cleveland and a graduate of Cornell University, died on February 17. Before joining the Ferguson staff 16 years ago, he was with the Rust Engineering Co., of Pittsburgh.

Orval Lee Gearhart (A.M. '19), age 82, in retirement since 1941, died at his home in Dixon, Ill., on January 11. At various times Mr. Gearhart had been road paving engineer for Ogle County, engineer of construction on southern Illinois railways, and highway engineer for the Illinois State Division of Highways. He was a graduate of the University of Illinois, class of 1897.

Morris Trafton Griffin (J.M. '51), age 28, second lieutenant, U.S.A.F., stationed at Williams Air Force Base, Ariz., was killed in an airplane accident near Parker, Ariz., on December 8. Mr. Griffin received his bachelor of science degree from the University of Alabama in June 1951.

Marvin Furr Hartsfield (A.M. '48), age 39, employed by the Tennessee Valley Authority's Kingston (Tenn.) Steam Plant and a resident of Harriman, Tenn., died at Oxford, Miss., on January 14. Previously Mr. Hartsfield had been with the Guy F. Atkinson Co., and the J. A. Jones Construction Co., Richmond, Wash.; the Berg-Hartsfield Co., Lincoln, Nebr.; and the Mississippi State Highway Department. He was a graduate of the University of Mississippi and a Navy veteran of World War II.

Halvar Olsen Hem (M. '11), age 89, chief engineer of the Toledo Scale Co., from 1928 until his retirement in 1948, died at his home in Toledo, Ohio, in January 1953. Earlier, Mr. Hem was associated with the H. H. Strait Mfg. Co., of Kansas City, Mo., for more than 25 years, advancing to vice-president. Holder of more than 150 patents for industrial inventions and designer of most wind tunnel measuring devices in use in this country, Mr. Hem had been honored by many technical societies.

Sigvald Johannesson (M. '16), age 75, of Princeton, N.J., designer of the Pulaski Skyway between Newark and Jersey City, N.J., died in Trenton on February 22. Mr. Johannesson, who was with the New Jersey State Highway Department from 1924 until his retirement in 1948, was previously connected with the Interborough Rapid Transit Company, and the Pennsylvania Railroad. He was an alumnus of the University of Copenhagen.

Yazujian Mardig Karekin (M. '26), age 72, consulting engineer of New York City in private practice since 1921, died at his home in Dumont, N.J., on December 18. From 1906 to 1921, Mr. Karekin was on the staff of Westinghouse, Church, Kerr & Company. During World War II, he was connected with the Reconstruction Finance Corporation.

Lester Josef Newman Keliher (A.M. '22), age 61, president of the Keliher Construction Co., Dallas, Tex., died on January 18. Mr. Keliher founded his firm in 1920 and for many years was located in Little Rock, Ark. He was a graduate of the University of Michigan.

Karl Quill Kirk (A.M. '43), age 73, of Chattanooga, Tenn., died on January 26. Mr. Quill had been associated with the Mark K. Wilson Co., of that city as an engineer and estimator since 1925. Earlier he worked briefly for R. H. Hunt, and Louis H. Bull, Chattanooga architects.

John Elmer Maring (M. '51), age 52, since 1947 city engineer for Kansas City, Mo., died on January 12. In 1940 Mr. Maring entered municipal service in the Department of Public Works, becoming Commissioner of Streets and Sewers in 1943. Previously he had been with the Missouri State Highway Department at Jefferson City.

James Walter Martin (A.M. '14), age 70, of Montgomery, Ala., died on February 15. With the U.S. Bureau of Public Roads in Montgomery for 22 years, Mr. Martin was district engineer in charge of the Alabama office at the time of his retirement in 1952.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

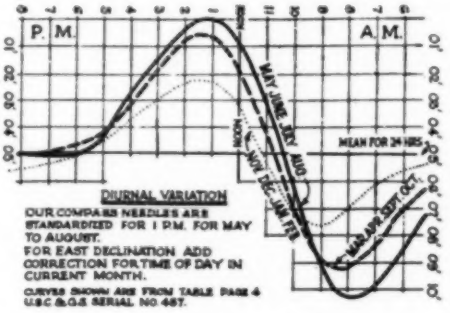
Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Are you getting the most from your compass?

"High precision is expensive and should be used only where necessary," says S. E. Huey, Consulting Engineer, Monroe, La. "The most important exercise of professional judgment is in the selection of precision. Rural land, route and stadia surveys can be run with errors of from 1:1000 to 1:2000.

"Modern American transits, like our Gurleys, are equipped with sensitive and accurate magnetic compasses which can be used for surveys of this order. Each compass needle has its individual declination from true north, but we standardize each transit by setting the compass declination circle permanently at zero.

"Then with transit on a magnetic station, and with both 'A' vernier and compass needle set carefully on zero, the angle between this setting on magnetic north and true north is turned and read on the 'A' vernier. Five or six separate settings and readings are made to get a consistent average. (If your transit will not read within one or two minutes of arc, order a new center pin, as the point may be dull.)


P. M.
A. M.
MAY JUNE JULY AUG
NOV DEC JAN FEB
MEAN FOR 24 HRS.
MAR APR SEPT OCT
DIURNAL VARIATION
OUR COMPASS NEEDLES ARE STANDARDIZED FOR 1 P.M. FOR MAY TO AUGUST.
FOR EAST DECLINATION ADD CORRECTION FOR TIME OF DAY IN CURRENT MONTH.
CURVES SHOWN ARE FROM TABLE PAGE 4 U.S.C. & G.S. SERIAL NO 487.

"Since the maximum westerly position of the needle occurs at 1:00 P.M., minimum east declination or maximum west declination would occur at this time. Our transits are standardized for 1:00 P.M., and declination and date noted on a sticker in the transit box. Magnetic declination for the transit and station can be quickly obtained from current editions of C.A.A. charts. On compass surveys, correction for position and time of day can be applied to the declination.

An authority on compasses, S. E. Huey of Monroe, La., uses nearly 20 Gurley instruments in his work.

"Set the declination on the 'A' vernier and bring the compass needle to zero position. The transit is now oriented with true north.

"When these corrections are made by an experienced 'Compass Man,' surveys with allowable error of 1:3000 can be made. No rear rodman is needed, and clearing for line is reduced to a minimum. Errors in lining in points are compensating rather than propagating, as for transit lines.

"Fear of local attraction is sometimes an excuse for lack of confidence in the magnetic compass. It can often be dispelled by getting rid of metal objects on or near the surveyor. But when it is impossible to eliminate this attraction or when magnetic storms cause erratic action, a survey can be continued by conventional transit line."

What's your story? We would like to feature it in a future page in this series. Drop us a line, outlining your idea. We'll contact you later for full details.

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W. & L. E. GURLEY, 518 FULTON STREET, TROY, N. Y.

Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments.

GURLEY

Surveying and Scientific Instrument Makers
Since 1845

He was a graduate of The Citadel in Charleston, S.C., and had for some time been engineer for the Sanitary and Drainage Commission of that city.

George Augustus Mattison III (J.M. '51), age 24, lieutenant, U.S. Army, died recently while serving in Korea. Following his graduation from Alabama Polytechnic Institute in 1950, Mr. Mattison was employed as assistant plant engineer by the Woodstock Slag Corp., of Birmingham, Ala.

John William Moore (M. '09), age 87, consulting engineer and member of the firm of John Moore & Sons, Indianapolis, Ind., died on December 22. A specialist in municipal engineering, Mr. Moore designed the water-works systems in a number of Indiana communities. He was a graduate of Butler University, and engaged in railroad engineering early in his career, serving as chief engineer for several Western lines.

Edwin Paul Neilson (A.M. '39), age 57, since 1947 assessor of public utilities for the City of Buffalo, N.Y., died on January 18. Mr. Neilson became connected with the Buffalo Sewer Authority in 1936, and in 1939 was made assistant assessor of real property for the Board of Assessors. Earlier he had been building superintendent of the firm of Kidd & Kidd. He was a World War I veteran and an alumnus of Union College.

Lawrence Gilbert Parker (A.M. '16), age 72, retired engineer of Chicago, Ill., died on November 25. At the time of his retirement in 1950 Mr. Parker was associate structural engineer for the U.S. Coast Guard in Washington, D.C. He had also been with the Treasury Department and the Federal Works Agency. Earlier he had taught for eight years at the University of Chicago, his alma mater, and had been with two Chicago firms—Marshall & Fox and Probst & White—for a total of 22 years.

Boyd Edward Phelps (A.M. '37), age 51, president of Boyd E. Phelps, Inc., of Michigan City, Ind., died there on December 9. After graduating from Purdue University, Mr. Phelps worked in the state highway departments of Illinois, Michigan, and Indiana, and served on the Boards of Sanitary Commissioners at Gary and East Chicago, Ind. He entered private practice in 1938 as head of Phelps & Peck.

Clarence Haskell Potts (J.M. '50), age 25, ensign, U.S.N., died recently, according to information received at Society Headquarters. After obtaining the bachelor of science degree from the University of Mississippi in June 1950, Mr. Potts served his alma mater as an instructor in civil engineering.

Arthur Wallace Pratt (A.M. '26), age 72, since 1940 structural designer for the Phelps-Dodge Corp., of New York City, died in June 1952. Mr. Pratt had been engaged by several New York firms as a structural designer and engineer, including Weiskopf & Pickworth; McKenzie, Voorhees & Gmelin; and Buchman & Kahn. He was an alumnus of Rensselaer Polytechnic Institute, class of 1904.

Philip Tustin Samuel (Aff. '25), age 69, procurement director for the Maxon Construction Company, Inc., of Dayton, Ohio, died in New Orleans, La., on December 26. For more than 30 years, Mr. Samuel had served in the U.S. Army Corps of Engineers, holding the commission of lieutenant colonel in the recent war. He attended the University of Tennessee.

Thomas Francis Scholes (A.M. '46), age 38, president of T. F. Scholes, Inc., of Reading, Pa., was killed in an airplane accident on November 23. A graduate of the University of Illinois, Mr. Scholes worked for the Pennsylvania Railroad from 1936 until 1948, when he left to found his own firm.

Frank Charles Schroeder (M. '35), age 69, retired engineer of Dallas, Tex., died on February 2. A graduate of the University of Wisconsin, Mr. Schroeder taught for several years at the University of Washington and Columbia University. For 15 years he was connected with the Milwaukee Electric Railway and Light Co., and for five years with the Wisconsin Electric Power Co., both of Milwaukee.

George David Shannahan (A.M. '41), age 44, consulting engineer of Los Angeles, Calif., died on August 19. Following his graduation from the University of California, Mr. Shannahan joined the firm he was connected with during his entire career, now known as Shannahan Brothers, Inc.

Stephen Elliott Shoup (A.M. '14), age 68, former special representative of the president of the Kansas City Southern Railroad, died at his home in Kansas City, Mo., on December 12. Mr. Shoup was with the railroad company from 1911 until his retirement in 1950, with the exception of special work for the government and the Office of Defense Transportation on transportation problems. He was an alumnus of the University of the South.

John Dolson Slye (M. '44), age 67, former district engineer of the Wyoming office of the Bureau of Public Roads, died in Mesa, Ariz., on January 15. He retired in 1952 after serving for 33 years on assignments throughout Wyoming, New Mexico and Colorado. Mr. Slye had a bachelor's degree from the University of Colorado and a master's degree from the University of Michigan.

Thomas Arthur Smith (A.M. '09), age 72, vice-president of the Turner Construction Co., of New York City, since 1921, and a member of the firm for more than 50 years, died recently. Mr. Smith retired from active business in 1932 and was residing at Easton, Md. He was a graduate of Swarthmore College.

Frank Alfred Swertz (M. '47), age 64, consulting engineer of New York, N.Y., and a graduate of the Royal University of Ireland, died in January. Mr. Swertz was employed as a design engineer for the Harris Structural Steel Co., in New York, from 1938 to 1950. Earlier he was connected with several other New York firms, including Madigan-Hyland and C. J. Jeppesen Inc.

Hermann Von Schrenk (M. '25), age 79, consulting timber engineer for the firm of Von Schrenk & Kammerer, St. Louis, Mo., died on January 30. Since 1907 Mr. Von Schrenk had been consultant to several railroad companies—the New Haven, North Pacific, Missouri, Kansas & Texas, and Wabash lines. He was an alumnus of Cornell University, and had lectured for several years at Washington and Yale universities.

Warren Henry Thompson (M. '44), age 59, partner in the consulting engineering firm of Thompson, Beane, Gill & Schlenker, Buffalo, N.Y., died at his home at Kenmore, N.Y., on January 27. Mr. Thompson worked for the Corrugated Bar Co., the Kalman Steel Co., the Bethlehem Steel Co., and the Buffalo Steel Co., before entering private practice in 1946.

Raymond Verner Warren (A.M. '15), age 65, engineering representative for the Western Pennsylvania Sand & Gravel Association, Pittsburgh, Pa., for 22 years, died in Bellevue, Pa., on December 29. Previously Mr. Warren had served the Pennsylvania State Department of Highways at Harrisburg for several years as township engineer. At the time of his death he was secretary of the Ready-Mixed Concrete Association of Pittsburgh.

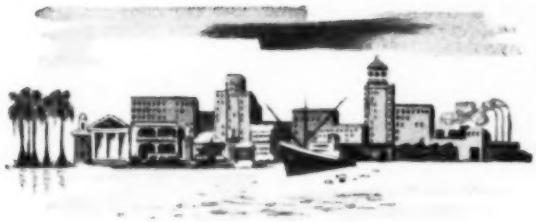
Clement Tehle Wiskocil (M. '35), age 62, professor of civil engineering, at the University of California at Berkeley, and a member of the faculty since 1914, died during the fall of 1952. Professor Wiskocil was instrumental in forming the Student Chapter at the university which he served as Faculty Adviser for a number of years. For the past seven years, students under his guidance at the U. of C. have won the Daniel W. Mead Student Prize. He was also immediate past-president of the San Francisco Section. Professor Wiskocil was an alumnus of the University of Wisconsin, class of 1913.

Fritz Leroy Washburn (A.M. '22), age 66, consulting engineer of Decatur, Ill., died on December 5. Mr. Washburn had served for many years as chief engineer of the Macon County Highway Department at Decatur. He was engaged in railroad engineering in the early part of his career.

Solution to problem on page 59

The wall as sketched was eccentric on the bearing area. When investigated the wall proved to have a normal spread footing which extended outward from the wall as well as inward; it was entirely safe and more than adequate.

Mobile Prefers Concrete Pressure Pipe



Part of the new water supply project completed last year in Mobile, Alabama, included the installation of sixteen miles of concrete pressure pipe. Nine miles of 60-inch and seven miles of 48-inch pipe were laid to carry the 45,000,000 gallons of water Mobile uses in an average day.

Mobile engineers selected concrete pressure pipe because it is economical to install and maintain . . . it will carry water for generations without reduction in carrying capacity due to tuberculation or corrosion . . . and it is immune to rupture or blow-out.

Concrete pressure pipe offers these same advantages for the water systems of any size community. It is available in a wide range of diameters and can be installed to fit individual requirements. Let us show you how concrete pressure pipe can bring your community "water for generations to come."

Water for Generations to come

Concrete PRESSURE Pipe

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

NEWS OF ENGINEERS

L. M. Lawson has been reappointed American Commissioner of the International Boundary and Water Commission—a post he has held since 1927—by President Eisenhower. Mr. Lawson, an Honorary Member of the ASCE, was presented with the State Department's Superior Service Award in 1952. He has been widely praised for his outstanding role in the negotiation of the treaty between the United States and Mexico for rectification of the Rio Grande. At the present time his major interest is the construction of Falcon Dam.

L. M. Lawson

Byron A. Bledsoe has been promoted to assistant manager and engineer of the Universal Concrete Pipe Company's Atlanta, Ga., plant. He joined the company in 1952 as an engineering representative, following work for the Highway Research Board in Washington, D.C.

Charles A. Blessing is leaving Chicago, where he has been director of planning for the Chicago Planning Commission, to assume the position of city planning director for Detroit.

Bernard Blum, chief engineer of the Northern Pacific Railway since 1928, retired on March 1, after 46 years with the line. Mr. Blum began his long career with the Northern Pacific as assistant engineer and served successively as roadmaster, assistant district engineer, district engineer and maintenance-of-way engineer. **H. R. Peterson,** assistant chief engineer, succeeds Mr. Blum as chief engineer. Other changes in personnel include the promotion of **D. H. Shoemaker,** district engineer to assistant chief engineer, and **W. R. Bjorklund,** principal assistant engineer to district engineer.

Charles C. Bonin, project manager of Overseas Consultants, Inc., of New York City, is supervising construction work now being initiated on the Kamishiiba Arch Dam in Miyazaki Prefecture, Kyushu, Japan. Supervision of the design of the arch dam and spillway is under **Harry W. Stuber,** assisted by **Alfred L. Parme** and **M. F. Fornerod.**

Charles G. Bourgin has assumed new duties as engineer and general manager of the East Orange (N.J.) Water Department and secretary to the Board of Water Commissioners of the City of East Orange. He recently resigned as superintendent and engineer of the Montclair Water Bureau.

Thomas W. Brockenbrough, assistant professor of civil engineering at Virginia Polytechnic Institute since 1949, has been appointed associate professor of civil engineering at the University of Delaware. Earlier Professor Brockenbrough worked in industry as an aircraft stress analyst with the Glenn L. Martin Co., and the Douglass Aircraft Corp.

William G. Buecheler, colonel, U.S. Army Reserve, recently took over the command of the 3053 ASU Jacksonville ORC School. Colonel Buecheler was selected for this assignment from a group of officers representing all army branches. Previously he was serving as deputy engineer in the engineering section of Third Army Headquarters.

Samuel D. Cooper announces the admission of **William A. Chalkley** to partnership in the firm of Cooper and Perry, of Knoxville, Tenn., which will now be known as Cooper, Perry & Chalkley, Architects-Engineers. Mr. Chalkley was formerly plant engineer for the Rohm and Haas Co.

Patrick J. Cusick, Jr., former planning engineer of Montgomery County, Md., has been appointed assistant director of the Pittsburgh Regional Planning Association.

Lewis A. Dickerson, who recently resigned as chief of the Photogrammetric Division, Army Map Service, is now consultant for Lockwood, Kessler & Bartlett, Inc., of Great Neck, N.Y. He will assist with economic and resources surveys, and in location, design, and engineering projects.

Robert G. Dwyre has been assigned to duty with CBMU No. 1, F.P.O. San Francisco, Calif. Mr. Dwyre received the degree of bachelor of science in civil engineering from the New Mexico College of Agriculture and Mechanic Arts in June 1952.

Raymond E. Hall, engineer and chief deputy, Lucas County Engineering Department, Toledo, Ohio, has been named to the newly created post of Lucas County sanitary engineer.

Mark P. Harris, assistant professor of engineering drawing and mechanics at the Georgia Institute of Technology, has joined the faculty at Pennsylvania Military College as professor of civil engineering.

Donald Johnson, former chief of the soil section, Sacramento District, U.S. Engineer Department, has been transferred to the San Francisco District in a similar capacity.

John C. Oliver, city engineer of Vancouver, B.C., Canada, has been elected president of the British Columbia Association of Professional Engineers.

Scott P. Hart, since 1950 connected with the Alaska Road Commission at Valdez, was recently named chief engineer of the Montana Highway Department—a post he previously held for a period of 14 months in 1948–1949. His headquarters will be in Helena. Mr. Hart was a member of the Montana Highway Department for many years before going to the Alaska Road Commission.

Harry E. Jordan, secretary of the American Water Works Association has been awarded the Fuller Award for this year by the association's New York section. He is a past-president and honorary member of the AWWA.

Edward F. Koch, district engineer for the U.S. Bureau of Public Roads at Ames, Iowa, is the new chief engineer for the Iowa State Highway Commission at Ames, succeeding **Fred R. White,** who retired September 1.

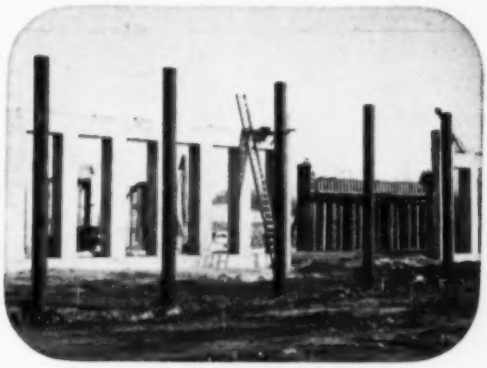
Robert G. Macdonald, lieutenant colonel, Corps of Engineer, recently on active duty as post engineer, Utah General Depot, Ogden, has been released from service and is now civilian chief, Facilities Branch, Office of the Quartermaster General, in Washington, D.C.

Byron W. Matteson, division engineer for the U.S. Bureau of Public Roads in Colorado, Wyoming, Utah and New Mexico, retired on March 1, after more than 33 years of service with the Bureau. In 1952 he was presented with the Department of Commerce Gold Medal Award for outstanding work in national highway development.

Lester Rogers, president, Bates & Rogers Construction Corp., Chicago, and **William E. Schubert,** vice-president and general manager, Wisconsin-Michigan Power Co., Appleton, Wis., are among those named by the University of Wisconsin as the nation's

Charles G. Richardson (left), vice-president of Builders-Providence, Inc., a division of Builders Iron Foundry, Providence, R.I., receives a watch and billfold from Henry S. Chafee (right), treasurer, at the company's annual service award dinner, in recognition of 50 years of service.

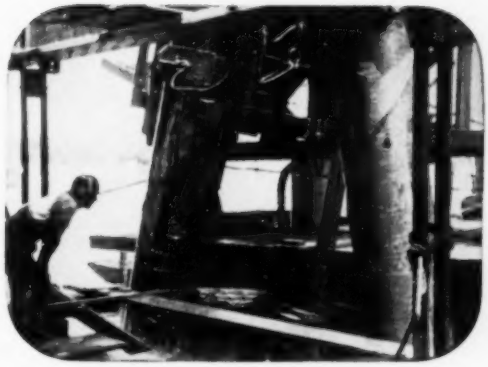
Piles for railway underpass.



Piles for super-highway bridge.

Piles for sewerage treatment plant.

Piles for railway bridge.



Here's the "straight story" on pipe piles

Straight foundation pipe supports maximum loads. This is why so many engineers like Armco Spiral Welded Pipe Piles — they have exceptional straightness and roundness.

Because of the tough spiral weld of Armco Pipe Piles you get high collapse resistance and extra lateral stiffness even in the longest lengths. And because Armco Piles drive straight, driving time is saved and jobs are completed on schedule.

Diameters range from 6 to 36 inches and wall thicknesses are from $\frac{9}{64}$- to $\frac{1}{2}$-inch. Piles can be supplied in any length that can be handled and shipped.

End plates, points and cutting shoes can be mill-attached, thereby eliminating inconvenience and field welding. And with the uniform diameter of Armco Piles—end to end—it is easier to salvage cut-offs for extending short piles or making new whole piles. Waste is avoided.

Specify Armco Pipe Piles for that next foundation job. Write for more data. Armco Drainage & Metal Products, Inc., 2693 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO

PIPE PILES

ARMCO

Transite Pipe is a product of modern engineering and research. Shown above is one of the buildings at the Johns-Manville Research Center at Manville, New Jersey.

*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE

TRANSITE PIPE last longer California city streets?

Transite Pipe was first installed by this California city nearly 20 years ago. Its lasting strength and high corrosion resistance have enabled it to outlast pipe previously used several times over.

Research designed it for lasting strength

TODAY, ACROSS THE COUNTRY—under countless city streets like the one shown above—Transite® Pressure Pipe is doing a highly efficient job of transporting water . . . often under conditions so adverse to ordinary pipe that engineers marvel at Transite's ability to stand up through the years!

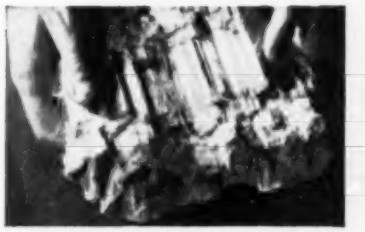
The reason? *Lasting strength!*

Not only does Transite Pipe have the *initial* strength that's needed in a pipe intended for use under busy city streets. Equally important, it has the *lasting* strength that enables it to survive continued corrosive attack, year after year . . . to keep on giving the same dependable, economical service to the community as the day it was installed.

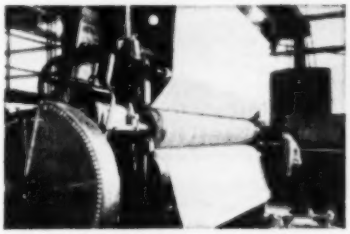
This highly important quality of lasting strength is one of many notable inherent advantages of a pipe engineered with modern water transportation requirements in mind. Transite's Simplex Couplings reduce leakage losses to a minimum, provide flexibility to help relieve the line of soil stresses and traffic loads. Its light weight makes for easier handling and effects substantial savings during installation. Its smooth interior assures a high coefficient of flow (C=140) and, because Transite can never tuberculate, helps keep pumping costs low through the years.

Why not get all the details . . . find out how this modern-engineered-for-the-job asbestos-cement pipe can help solve your water-line problems and *save you money?* For full information, write Johns-Manville, Box 60, New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS



Tough, strong asbestos fibers reinforce Transite Pipe—contribute to its high corrosion resistance and lasting strength.



On machines like this, the asbestos-cement-silica mixture is "built up" under heavy pressure into a dense, homogeneous pipe structure.

Transite's flexible Simplex Couplings help relieve the line of excessive flexural stresses—an added safeguard against pipe failures.

asbestos-cement PRESSURE PIPE

1. Orinoco Mining Company's new ore and cargo handling dock on the Orinoco River, Venezuela. Composed of 3 units, this DeLong dock is 1,130 ft. long, 82 ft. wide, and 15 ft. deep.

DeLong AIRJACK TRANSFORMS SEA-GOING DOCK-BARGE INTO ORE AND CARGO PIER!

Cuts time, costs!

Field work is practically eliminated in dock construction, due to the development of the patented DeLong Airjack. This new technique of dock construction speeds installation, cuts costs.

The DeLong Airjacks, which are the key to the whole transformation of barge to pier, enable the dock to "climb" the steel columns, or caissons, to required elevation. After the self-lifting operation, caissons are driven to refusal for permanent installations. Caissons are welded to deck and cut off flush; then filled with concrete or sand and tops closed with welded cover plate.

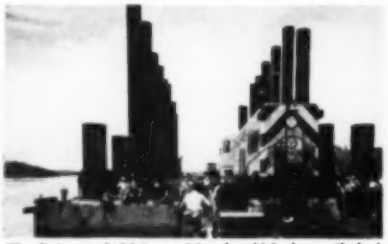
More than ½ million sq. ft. of the DeLong type of pier are in use or under construction in diversified locations that range from the Arctic to South America.

The DeLong Airjack can cut time and costs in the construction of offshore oil well drilling platforms, portable and permanent piers, and many other types of installations. A DeLong dock can be erected and, after having served its purpose, jacked back to water level and towed to a new location.

2. A week after arrival at Orinoco River site, first dock section 376 ft. long berths ship, and unloading begins. Two additional units make this pier 1,130 ft. long.

3. Loaded dock section, fabricated at an Orange, Texas yard, arriving at site on Orinoco River, after being towed across 3,000 miles of ocean. Dock carried caissons, crane, Airjacks, compressors, generators, other installation gear.

4. Crane placing 6 ft. diam., 100 ft. long steel caissons in wells fitted with Airjacks. Crane, Airjacks and other equipment were later transferred to second and third sections for erection purposes.



5. Caissons held in position by Airjacks until dock barge is jockeyed into final position. Caissons are then dropped to river bottom and DeLong Airjacks lift dock to final elevation. Control is so precise, height of dock can be regulated to 1/32 of an inch.

DeLong
Engineering & Construction Co.
29 BROADWAY, NEW YORK 6, N. Y.
Phone: HAnover 2-1275

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"leading engineers and industrialists." Both are graduates of the university's college of engineering, and will be cited for their accomplishments at the annual Engineers' Day celebration on April 10.

John D. Officer, former assistant field engineer with the U.S. Bureau of Reclamation at Hungry Horse, Mont., has accepted a position in contract administration with Peter Kiewit Sons at Portsmouth, Ohio.

W. S. Pardoe, who recently retired as professor of hydraulic engineering at the University of Pennsylvania, is now associated with the staff of the Olden Hydraulic Laboratory at Worcester Polytechnic Institute where he will continue his experimental work. The trustees of the University of Pennsylvania have elected Professor Pardoe emeritus professor of civil engineering.

Frederick A. Reickert has rejoined the staff of Hazelet & Erdal in Chicago, Ill., following completion of 20 months' active duty with the U.S. Air Force. Prior to this period of service, Colonel Reickert was for three years an associate professor of civil engineering at the University of Illinois.

Bernard L. Robinson, brigadier general, Army Corps of Engineers, will serve as chairman of the Board of Engineers for Rivers and Harbors in addition to his duties as Army Assistant Chief of Engineers.

Charles A. Schaefer, since 1945 structural designer with Charles S. Whitney, consulting engineer of Milwaukee, Wis., is now employed as a structural engineer with Gahan and Sons Construction Co.

James H. Roach, who recently retired as consulting engineer for the New York Central Railroad, announces his availability for consulting services—investigations, reports, valuation, rates, taxes, sales, purchases and allied fields—at 76 Dellwood Road, Bronxville, N.Y.

Ivan C. Crawford, engaged in consulting work in Boulder, Colo., for the past two years, was recently appointed director of the Colorado Water Conservation Board. Mr. Crawford has been living in Boulder since his retirement in 1951 as dean of the college of engineering at the University of Michigan. A well known engineering educator, Mr. Crawford also has been dean of engineering at the universities of Kansas and Idaho. He was Director of ASCE from 1935 to 1937 and chairman of the Society's Education Committee for two years.

Ivan C. Crawford

Mohammad Kabir Ludin of Afghanistan, has been named president of the United Nation's Technical Assistance Conference.

George W. Howard, chief of the Engineer Research and Development Laboratories, Fort Belvoir, Va., recently received a Rockefeller Public Service Award for outstanding public service. The $15,000 grant will enable Mr. Howard to spend a year visiting government, private research and development agencies in this country and abroad. Mr. Howard has been associated with the Corps of Engineers since 1932, both as an officer and a civilian.

George W. Howard

Norman E. Schlenker, formerly supervising engineer for Seelye, Stevenson, Value & Knecht, New York City, has entered into partnership with **James F. Gill** and **John A. Beane.** The firm, now known as Gill, Beane and Schlenker, is located at 775 Main St., Buffalo 3, N.Y.

Leslie E. Sandvall recently completed a tour of active duty with the Corps of Engineers and has returned to his position as civil engineer with the Engineering Division of the Omaha District of the Corps. A reserve colonel, he was on duty at the 2nd Army Headquarters and commanded the 338 Engineer Combat Group.

Charles M. Slaymaker of Springfield, Ill., retired in January, after 26 years of service with the Illinois Division of Highways. Mr. Slaymaker began his tenure with the department upon graduation from the University of Illinois in 1908, and has served continuously in capacities varying from junior to district engineer.

Mead and Hunt, Inc., consulting engineers of Madison, Wis., announce that **Willard W. Warzyn,** chief structural engineer, and **Donald B. Johnson,** structural designer, have become members of the firm. Both men have been associated with Mead and Hunt since 1947.

Uel Stephens, director of the Fort Worth City Water Department, was recently named president of the Texas Construction Council.

H. G. Wood, who joined the staff of the Portland Cement Association in 1937, as a field engineer for the Columbus, Ohio, office, has been promoted from state-wide paving engineer to district engineer for the Columbus headquarters.

J. R. Yarrow is returning to the United States after 21 months in Morocco for Porter-Urquhart, Skidmore, Owings & Merrill, Associated, consulting engineers responsible for the planning, design and inspection of the airfield projects being built for the government under the direction of the Corps of Engineers.

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Men Available

CIVIL ENGINEER; J. M. ASCE; 24; single; B. of C.E.; field engineer; 2 years' diversified field and office experience on preliminary surveys and construction of earth-fill dams, highways, hydro and steam power stations. Seeks position where initiative and drive are a prerequisite; New York area preferred. Certified Professional Engineer-in-Training by New York State. C-823.

CIVIL ENGINEER; J. M. ASCE; B.C.E., M.C.E.; 30; married; 2 years' reinforced concrete design; 4 years' teaching in structures and fluid mechanics; 2 years' in charge of construction on heavy reinforced concrete buildings. Desires position in design or construction; would consider attractive teaching position. Location preferred, East. C-824.

CIVIL ENGINEER; M. ASCE; 35; married; graduate; registered civil engineer in California; speaks French fluently; 6 years' structural design, buildings, waterfront work, power plants; 5 years' city office and design engineer, streets, sewerage, storm drains, bridges; seeks office engineering position in France or French possession. C-825-529-A-2-San Francisco.

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CIVIL ENGINEER; J. M. ASCE; 29; field experience in footings, marine piers and steel superstructure on large bridges; design of limited access highways, interchanges, utility relocations; 1½ years' superintendent and engineer for contractor on earthwork, pipelines, and estimating. Seeks permanent position with growing firm. C-826.

CIVIL ENGINEER; J. M. ASCE; 30; married; veteran; B.S.C.E., 1950; graduate evening courses industrial engineering; 3 years' tool and die experience; 3 summers in construction-surveying; 1 year application and sales of pumps and diesel-generators; 2 years' aircraft structural engineer; all around administrative experience. Seeks management or estimator position with small company in Westchester, Manhattan or northern New Jersey. C-827.

SALES ENGINEER; J. M. ASCE; B.S. in civil engineering; 29; married; experienced in sales engineering for a major company; just completed 2 years' obligated service Lt., Civil Engr. Corps, USN, as Public Works Officer in charge of construction and repair of naval station. Available May 1, 1953; prefers West Coast. C-828-532-A-3-San Francisco.

ASSISTANT CIVIL ENGINEER; J. M. ASCE; 25; married; B.S. in C.E., 1949, University of California; 2½ years' experience in design and construction of highways, streets, piers, wharves, powerhouses, buildings, overhead electric trolley systems. Desires position with constructor, consulting engineer or municipality. Available June 1953 upon release from active duty as officer with U. S. Coast Guard. Location preferred, California. C-829-493-A-3-San Francisco.

CIVIL ENGINEER; J. M. ASCE; 29; married; B.C.E.; 4½ years' experience in structural design including bridges and special heavy structures for power plants and dams. Desires position not confined entirely to design office. Location, eastern states except larger cities. C-830.

CIVIL ENGINEER; J. M. ASCE; 34; married; 7 years' experience in industrial building design, highway construction, bridge construction, planning and coordinating construction work. Desires responsible work with construction contractor. Location preferred, West or Midwest. C-831.

CONSTRUCTION ENGINEER; J. M. ASCE; 28; single; graduate of University of Sydney, bachelor of engineering in civil engineering, 1950. Available July 1, 1953. Location preferred, Canada or the Far East. C-832-533-A-1-San Francisco.

REGISTERED ARCHITECT; A. M. ASCE; 50; married; with 24 years' experience in design of industrial, schools, institutional, recreational, monumental and ecclesiastical buildings and liaison ability; desires position with engineering firm. Will serve as assistant to executive. Presently available. Prefers Eastern location. C-833.

CONSTRUCTION ENGINEER; J. M. ASCE; 29; B.C.E., Clarkson Tech.; 1½ years' field and office experience on highways, 3 years' building construction experience (15 months as project engineer on 10 million dollar IBM addition). Desires responsible position stateside, or abroad with family status and will relocate except to Eastern seaboard. C-834.

CIVIL AND STRUCTURAL ENGINEER; J. M. ASCE; 29; married; B.S. in A.E., B.E. in C.E., U. of Alabama; 5 years' experience, public works department and assistant resident engineer on military bases, assistant to consulting engineer municipal projects. Desires civil or structural work, U. S. A. C-835.

Positions Available

JUNIOR CIVIL ENGINEERS, graduates, with about 1 year's experience in general civil engineering and some knowledge of streets and sewers. Salary, $3,500–$4,100 a year. Must be residents of northern New Jersey. Y-6856(b).

CIVIL ENGINEERS, 25–35, for work in sales promotion, should have 4 to 5 years' experience in building materials field. Should have design and construction background. Salary, open. Headquarters, Cleveland, Ohio. Territories, Detroit, Cleveland and Pittsburgh area. Y-7663.

STAFF ENGINEER, construction, 30–45, with civil engineering degree preferred, and up to 10 years' experience in similar work described below. Will act as office engineer and resident engineer on industrial plant changes and expansion, large and small projects. Broad experience required in building construction. Knowledge of equipment erection desirable. Able to review structural designs and suggest improvements, make cost estimates, review proposals and advise on letting contracts. Act as company representative on projects away from home office. Travel required. Salary, $5,400–$6,800 a year. Location, New Jersey. Y-7820.

STRUCTURAL ENGINEER, 33–39, with 5 to 10 years' broad experience in design and construction in both the structural steel and concrete fields. Should have a degree in civil engineering or architectural engineering. Experience should be preferably in the engineering department of a petroleum refining or chemical company of a contracting firm constructing such facilities. Location, Maryland. Y-7991.

TEACHING PERSONNEL. (a) Instructor in civil engineering, 25–35, B.S.C.E., no experience required. Degree may be in architectural engineering. Will teach undergraduate courses in surveying and architectural construction. Salary, $4,000–$5,000 a year. Research contract work available for extra compensation. Employer will negotiate placement fee. (b) Instructor in civil engineering, 30–40, master's degree in civil engineering, 5 years' experience teaching or design in hydraulics and reinforced concrete. Will teach undergraduate and graduate courses, supervise research. Salary, $5,000–$6,000 a year. Research work available for extra compensation. Employer will negotiate placement fee. Location, Kentucky. Y-8012.

PROJECT MANAGER, 35–40, civil graduate, with at least 5 years' construction supervisory experience covering industrial buildings and heavy construction, to plan projects, schedule work and be responsible for performance of superintendents on various projects. Salary, $7,500–$7,800 a year. Location, Maryland. Y-8064.

ASSISTANT CHIEF STRUCTURAL DESIGNER, about 35, on steel, concrete and timber, with particular emphasis on bridges and railroad work. Salary, $6,000–$6,300 a year. Location, New Jersey. Y-8076.

MANAGER OF WATER WORKS AND SEWER DEPARTMENT, preferably civil engineer, with water works and sewer design experience, plus managerial ability. Salary, $6,000 a year. Location, Tennessee. Y-8098.

SENIOR CONSTRUCTION ENGINEER, up to 45, with degree in civil, architectural or construction engineering with 6 to 10 years' experience in the engineering field. Will render general assistance, supervising office and field work involving the construction of buildings, airports, sewers, industrial installations and houses; supervising con-

(*Continued on page 96*)

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(*Continued from page 94*)

tract work, preparing engineering specifications, drawings and cost estimates for new work and requisitioning materials for contractors on the job and maintaining flow of materials to construction sites. Must go single status for 6 months to a year. Salary, about $11,000 a year. Location, Venezuela, South America. Y-8154.

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FIELD ENGINEER, 26–35, civil graduate, with bituminous paving experience, for sales and construction supervision of rubberized bituminous pavements, covering special work on roads and airports. Some traveling. Salary, $5,000–$6,000 a year. Headquarters, New York Metropolitan area. Y-8215.

ASSISTANT PROFESSOR in civil engineering with teaching experience, to serve under the department head. Position starts fall, 1953. Location, East. Y-8240.

FIELD ENGINEER, civil or mechanical graduate, with industrial building or heavy construction experience, to give line and grade, check equipment drawings and foundations, do cost work on chemical and refinery construction. Considerable traveling in U. S. A. Salary, $4,200 a year plus $7.50 per diem. Y-8270.

ASSISTANT CHIEF ENGINEER, under 50, preferably civil graduate, and a licensed professional engineer. Must have considerable experience in full charge of major construction projects. Should also be experienced in preparing technical reports and speaking before professional groups. Must be capable of making evaluations of proposed construction projects of considerable magnitude. Salary to start, $15,000 a year with opportunities for increased earnings. Location, New York, N.Y. Y-8291.

ASSISTANT PROFESSORS IN CIVIL ENGINEERING. Master's degree or higher and some practical and/or teaching experience. (*a*) One to teach a section in elementary plane surveying, a small group in railroad and highway surveying, and fluid mechanics. (*b*) One to teach a course in design of steel and timber structures and probably a course in indeterminate structures at the master's level. Location, Texas. Y-8309.

FIELD ENGINEER, civil graduate, with experience on line and grade, general layout, quantities covering grading, foundations, buildings, etc., for contractor on government project. Salary, $5,500–$7,500 a year. Location, eastern Maryland. Y-8319.

SURVEYING INSTRUCTOR with teaching or surveying experience, to teach at summer camp during the month of June. Salary, $100–$130 a week, plus room and board. Location, southern New York. Y-8312.

STRUCTURAL ENGINEER with 10 to 15 years' experience in reinforced concrete and structural steel design for electric utility work. Location, eastern Pennsylvania. Y-8331.

CIVIL ENGINEER, graduate, with 5 years' experience or more, preferably in municipal field for engineering department. Salary, open. Location, New Jersey. Y-8344.

ENGINEER-DRAFTSMAN, college graduate in civil engineering, for position in drafting room, handling design and detail drawings for railroad buildings and shop facilities. Experience desirable. Location, Southeast. Y-8350.

REGIONAL HIGHWAY ENGINEER, graduate civil engineer, B.S. or C.E., 30–45, 8 years' experience in concrete pavement design and construction, general highway engineering. Knowledge of soils technology would be valuable. Will act as concrete pavement specialist in cooperation with 3 or 4 district offices calling on state highway engineers and officials and those of cities, counties and Federal agencies in their territory, assisting in special problems of design, construction. Maintenance, analysis of troublesome problems. Will work for a trade association. Salary, to start, $6,900–$7,200 a year. Employer will pay one half of placement fee. Traveling, car and mileage furnished. Location, Kansas City, Omaha, Texas. T-9604(*a*).

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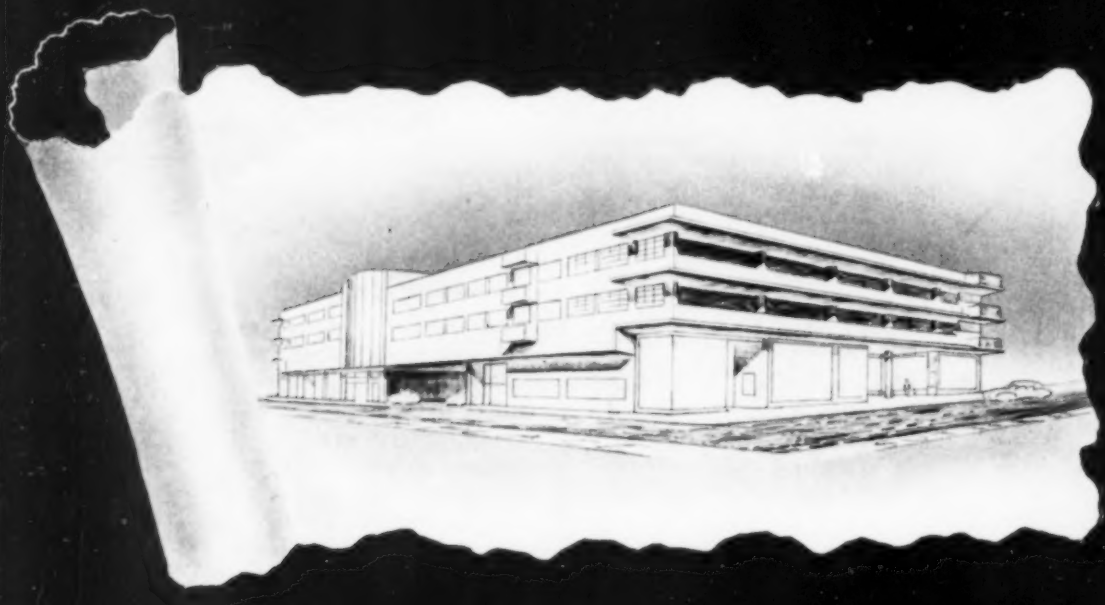

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IN THE BARRETT-LICK GARAGE nearing completion in San Francisco, the plans call for a large, unobstructed space in the entrance area . . . and to achieve this, four columns from the upper stories terminate at the second floor and are carried by the heaviest prestressed concrete girders ever constructed. Prestressed concrete was chosen because it allowed adequate headroom without increasing the story height . . . and, incidentally, there was a $6,000 saving (more than 11%) over the cost estimate for an alternative structural steel design.

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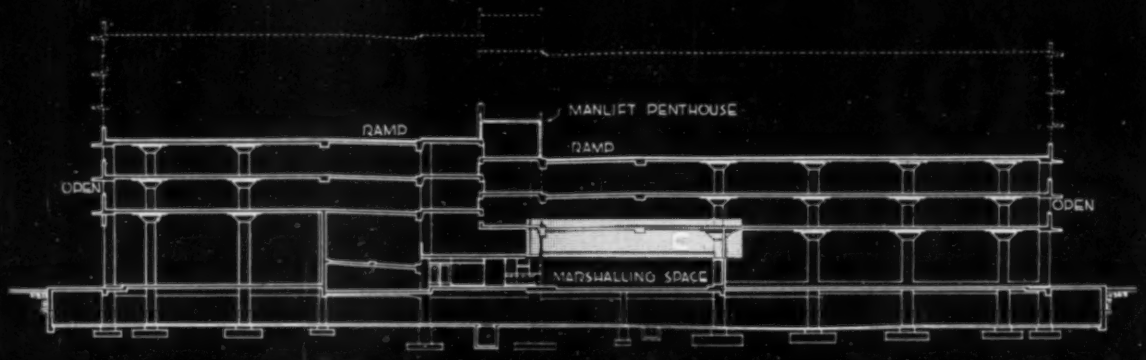

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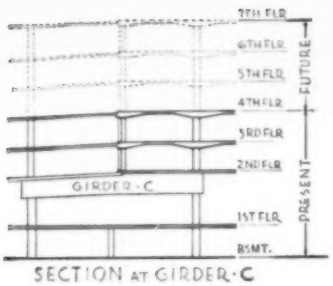
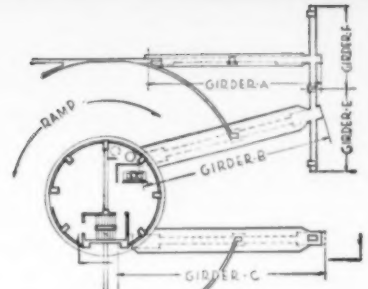


SECTION AT GIRDER-C

Open, unobstructed entrance area is indicated directly below girder "C". Note that the design includes provision for three additional stories. This section shows haunched slabs used in actual construction.

Plan view of five prestressed concrete girders, showing their arrangement to meet the free area requirements of this ultra-modern garage.



GIRDER PLAN

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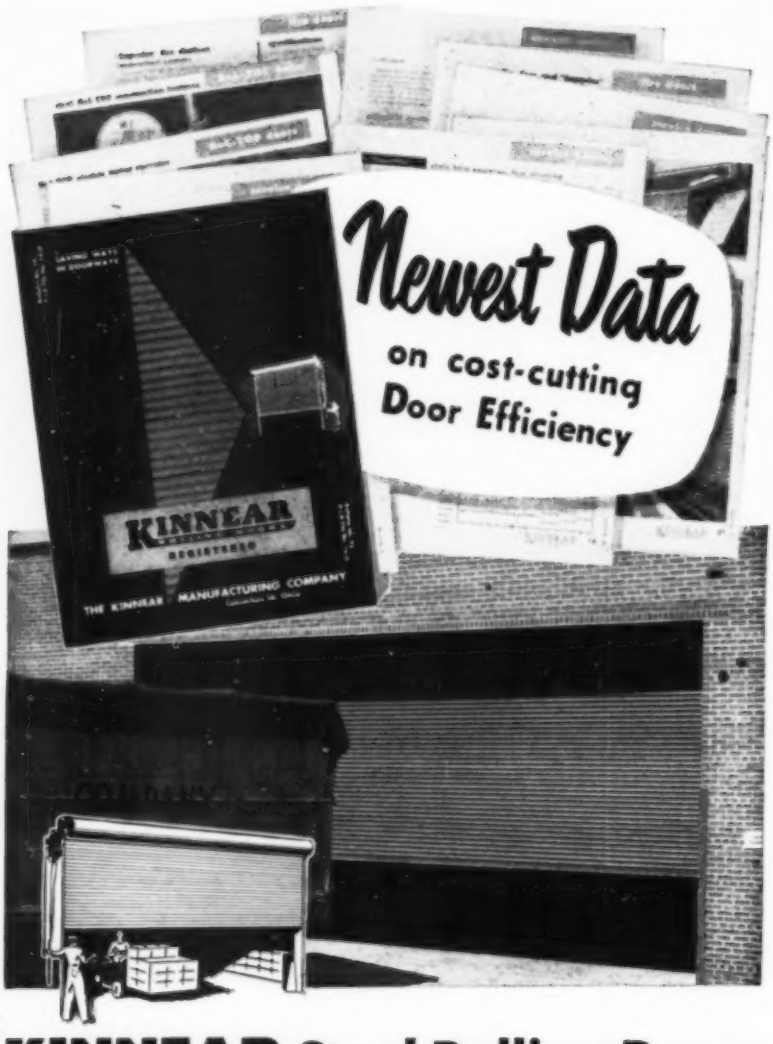

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Performance of Hydraulic Dredges Reviewed

(*Continued from page 62*)

the standard integral-type hull dredges. They can be built just as strong, and their advantage is that they can be moved easily by truck, rail, or ship. The moving cost compares favorably with that for moving large shovels and draglines. The *Colorado* and the *Western Chief* are examples of large, high-powered portable dredges.

In their article on bucket ladder dredges, Romanowitz and Sawin state that these can excavate harder material than hydraulic dredges. This writer has noted that hydraulic dredges have excavated medium-hard limestone without blasting where the bucket dredge was unable to do so. As for bucket dredges' carrying material for long distances and disposing of it, the practicability of conveying soft clay, silt or other material on a conveyor belt for 10,000 to 20,000 ft and then spreading it to an elevation of ±1 or 2 ft seems doubtful. This is required at present by the U.S. Corps of Engineers and other contractors. The bucket ladder dredge however has its definite place in gold and tin placer mining. In gravel and sand production and levee construction it is unexcelled.

As to the discussion of a large bucket ladder dredge for the proposed sea-level Panama Canal, in the ASCE 1948 *Proceedings*, there is also mention of large hydraulic dredges up to a 60-in. discharge. These latter could excavate most of the material, including rock, without blasting, and pump it with boosters directly into the proposed disposal area and levee sections. This would eliminate a large fleet of tugs and dump scows.

OLE P. ERICKSON, M. ASCE
Consulting Engineer

Tampa, Fla.

NEW IN EDUCATION

It is not too early for students and engineers interested in graduate scholarships, fellowships, assistantships, and other grants for the academic year 1953–1954, to make inquiries and file applications for such awards.

From the Bureau of Highway Traffic of Yale University comes an announcement that ten graduate fellowships for the study of traffic engineering—nine made available by the Automotive Safety Foundation and one by Rand McNally and Company—will be offered on a competitive basis to graduate students of highway engineering or those employed in the field. Application forms for the fellowships, which provide $1,400 for tuition and living expenses, may be obtained from the Director, Bureau of Highway Traffic, Yale University, Strathcona Hall, New Haven, Conn. They must be filed before June 1, 1953.

(*Continued on page 102*)

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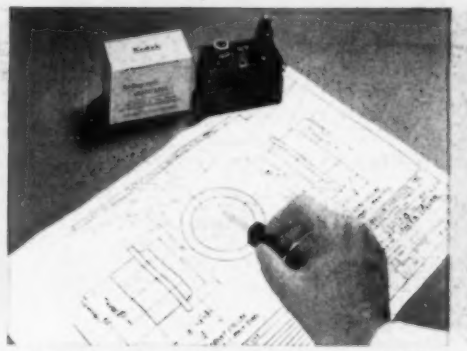

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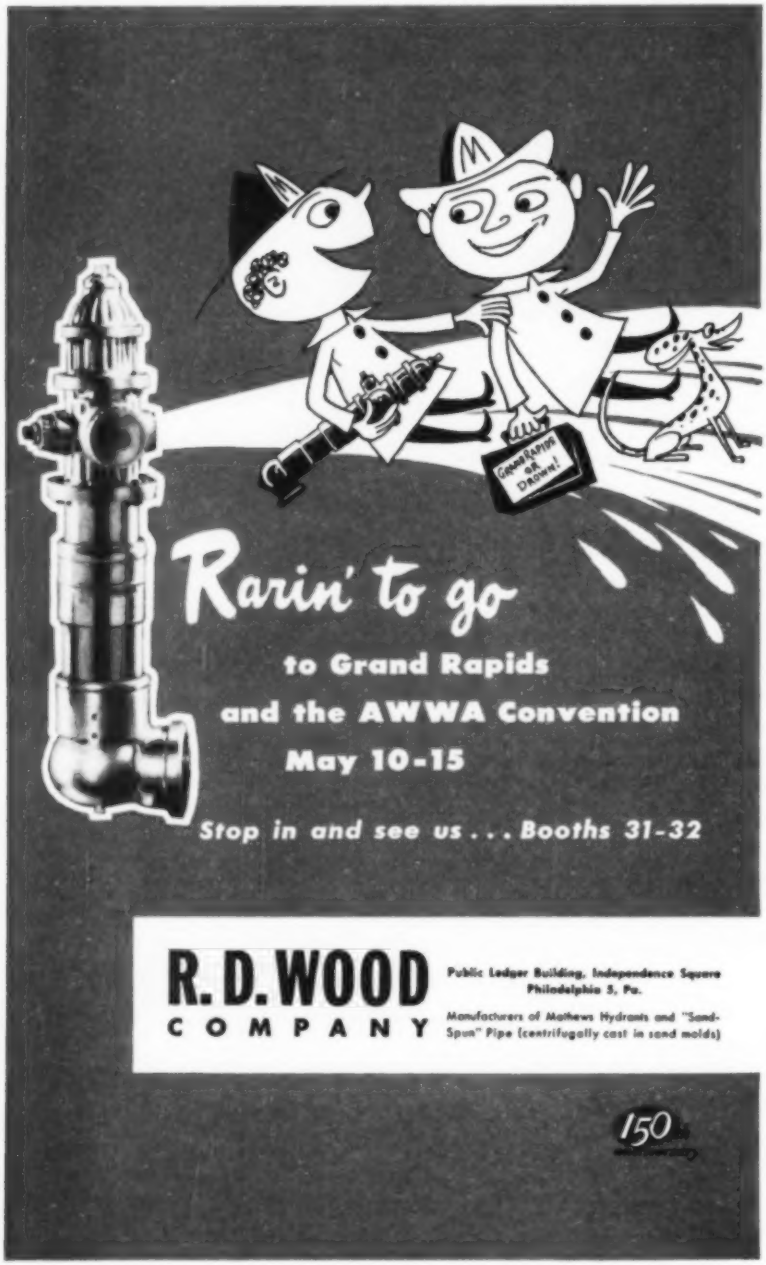
(*Continued from page 100*)

Graduate students may apply for part-time research assistantships in sanitary engineering leading to the master of science degree, given by the State College of Washington at Pullman. The salary is $1,400 for the first year and $1,490 for the second year, with the possibility of full-time employment during the summer. Further details may be obtained from Prof. Emmett B. Moore, Chairman, Department of Civil Engineering, State College of Washington, Pullman, Wash.

A recent gift of $20,000 to Lehigh University from the Lehigh Portland Cement Co., Allentown, Pa., will be administered through the regular university committee on scholarship grants and will be known as the Lehigh Portland Cement Company Scholarships. Applications for scholarships for the 1953–1954 academic year are now being received by the Office of Admissions, Lehigh University, Bethlehem, Pa.

Candidacies are invited for the Fuertes Alumni Medal awarded annually by the faculty of the school of civil engineering at Cornell University to holders of B.A., M.A., or Ph.D. degrees from that school, for a meritorious paper on an engineering subject. Applications should be sent not later than April 15 to Prof. Andre L. Jorissen, chairman of the Fuertes Alumni Medal Committee, Lincoln Hall, Cornell University, Ithaca, N.Y.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RECENT BOOKS

A "First Book" on Fire Safety in the Atomic Age

Essentially a discussion of the modifications and additions to peacetime fire safety measures which will be necessary in attempting to achieve effective control of atom-bomb fires. The author, Horatio Bond, deals briefly but clearly with primary and secondary fire effects, with proper construction and location of buildings, and with both passive and active pre-fighting methods. A considerable bibliography is included. (National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass., 1952. 72 pp., $1.)

Underpinning and Strengthening of Structures

This book, by L. E. Hunter, deals with cases which are likely to be met in the ordinary routine of the civil engineer, architect, building contractor, or municipal engineer dealing with buildings or bridges. The general object is to provide information on ways of prolonging the life of structures. Some specialized categories are dealt with—such as structures in subsoil subjected to heat, settlement and subsidence problems, etc. The examples have been taken from the author's past practical experience and are well illustrated by sketches and photographs. (Contractors Record and Municipal Engineering, London, 1952. 162 pp., 25s.)

Essentials of Fluid Dynamics

A translation of a recent German treatise (by Ludwig Prandtl) on the flow of fluids, intended to provide a comprehensive and easily understandable account of the subject, in which the mathematical treatment is held to a minimum. Major sections are as follows: Equilibrium of liquids and gases; kinematics and the dynamics of frictionless fluids; the motion of viscous fluids, turbulence, etc.; flow with appreciable volume changes (dynamics of gases); miscellaneous topics (combined effects, special flow problems, heat transfer in moving fluids, etc.). Many practical applications to hydraulics, aeronautics, and other subjects are included. (Hafner Publishing Company, 31 East 10th Street, New York 3, N.Y., 1952. 452 pp., $6.)

Dictionary of Conformal Representations

This unique book, by H. Kober, developed for the British Admiralty, contains a great many geometrical forms and their transformations, classified according to the analytic functions describing the transformations. The material included is of particular use in the fields of hydrodynamics, gas dynamics, free streamline theory, heat flow, magnetic field problems, soil mechanics, electrostatics, and map projection. Most transformations are illustrated by pairs of diagrams that show corresponding curves and corresponding regions. There is a topological subject index. (Dover Publications, Inc., 1780 Broadway, New York 19, N.Y., 1952. 208 pp., $3.95.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

Economic Studies for Richmond–San Rafael Bridge

This article begins on page 44

(*Continued from page 47*)

platform onto which a bell-bottom steel form is lowered. Finally, it becomes the bottom form for the concrete, which is poured inside the steel form to complete the pier.

Some may ask why a double-decked bridge was planned. There are two main reasons—safety and economy. It is proposed to use the three 12-ft lanes on the upper deck for mixed traffic in one direction and the three lanes on the lower deck for mixed traffic in the opposite direction, eliminating any possibility of head-on collisions. As the cost of a bridge varies almost directly with its width, it is evident that the structure as designed is much more economical than a bridge with six lanes on one level.

Probably the greatest economy in design was obtained by the use of reduced live loading for the longer spans and a method of "balanced design" used in the proportioning of the members of the structure. The dual unit stress method of "balanced design" was used in proportioning the structural members. For carbon steel a unit stress of 18,000 psi was used for live load and 24,000 psi for dead load.

A very small saving in materials was realized by using a reduced live loading, and this occurred only in the longer spans. However, the reduction in material by the use of "balanced design" was substantial and we believe produced a better proportioned structure.

Contracts Let

Before bids were received for the sale of the first block of $62,000,000 of revenue bonds, fully-guaranteed proposals for building virtually all of the bridge substructure and superstructure were received. Thus when bids were received for the bonds, full assurance could be given that the construction of 80 percent of the work would cost a definite amount. These costs were guaranteed and not dependent on engineers' estimates. It is very doubtful if a bid would have been received without such a guarantee. The sale of the bonds was consummated at par on February 26, 1953, with an interest rate of $3^{7}/_{8}$ percent.

On the same day contracts were executed for the substructure and superstructure work, and the underwater work started on March 2, 1953. The low bid of $14,234,550, submitted by Ben C. Gerwick, Inc., and Peter Kiewit Sons' Co., a joint venture, for the substructure contract was awarded on February 10. The engineer's estimate for this work was $14,562,000.

The superstructure contract was awarded to a joint venture composed of Peter Kiewit Sons' Co., A. Soda & Son, and Judson Pacific-Murphy Corp. They submitted a low bid of $21,099,319 compared to the engineer's estimate of $23,720,180.

Bids for approaches, administration building, electrical and other miscellaneous items will be received at a later date.

(This article has been prepared from the paper presented by Messrs. Raab and Tudor at the ASCE San Francisco Convention, before the Highway Division session which was presided over by Ralph A. Moyer, chairman of the San Francisco Section's Highways Committee.)

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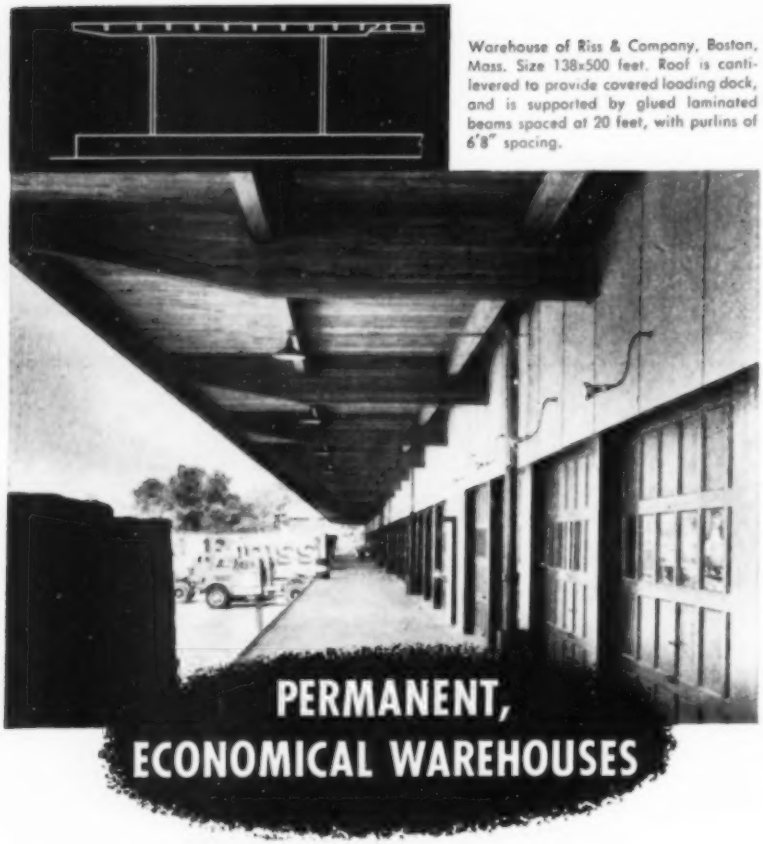

Warehouse of Riss & Company, Boston, Mass. Size 138x500 feet. Roof is cantilevered to provide covered loading dock, and is supported by glued laminated beams spaced at 20 feet, with purlins of 6'8" spacing.

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Non-ASCE Meetings

American Institute of Electrical Engineers. The Boston Section of the American Institute of Electrical Engineers will be host to the North Eastern District Meeting of the Institute, at the Sheraton-Plaza Hotel, Boston, Mass., April 29–May 1.

American Society of Mechanical Engineers. The spring meeting of the ASME will take place at the Deshler-Wallick Hotel, Columbus, Ohio, April 28–30.

American Water Works Association. The 73rd annual convention of the American Water Works Association will hold its technical sessions and exhibits at the Municipal Auditorium in Grand Rapids, Mich., May 10–15.

Chamber of Commerce of the United States. The forty-first annual meeting of the Chamber of Commerce of the United States will be held in Washington, D.C., April 27–29. Inquiries concerning reservations for special events should be directed to the Chamber of Commerce of the United States, 1615 H Street, N.W., Washington 6, D.C.

Chi Epsilon. A meeting of the New York Alumni Chapter will be held in the Engineering Societies Building, Room 1101, 33 West 39th St., New York City, on May 6, at 7:30 p.m. It will be preceded by an informal dinner in the New York Times Dining Room, 11th Floor, 229 West 43rd St., at 6 p.m.

Concrete Reinforcing Steel Institute. Headquarters for the annual meeting of the Concrete Reinforcing Steel Institute will be the Carolina Hotel, Pinehurst, N.C., April 27–May 2.

Conference on Instrumentation in Water, Sewage and Industrial Waste Treatment. The civil engineering department of Manhattan College, in cooperation with several companies in the instrumentation field, announces a conference on instrumentation in water, sewage and industrial waste treatment, to take place at Manhattan College, New York, N.Y., on May 14 from 9:30 a.m. to 5 p.m.

Fifth Pacific Northwest Industrial Waste Conference. The campus of Washington State College at Pullman, Wash., will be the scene of the fifth Pacific Northwest Industrial Waste Conference, April 16–17.

Eighth Purdue Industrial Waste Conference. The eighth Purdue Industrial Waste Conference will be held in the Purdue Memorial Union Building, Lafayette, Ind., May 4–6. Hotel reservations should be made at the Purdue Union Club, or the Fowler, Cedar Crest or Morris Bryant hotels.

Third Biennial Inland Empire Sewage Works School. The third Biennial Inland Empire Sewage Works School will hold sessions at the State College of Washington, Pullman, Wash., May 14–16.

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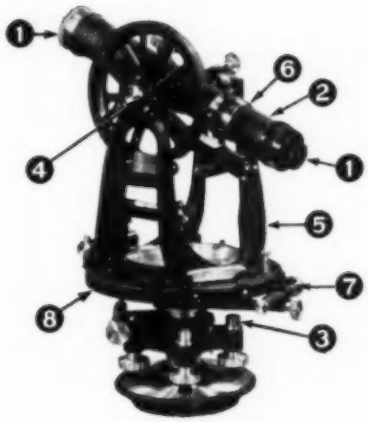

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BENJAMIN FAIRFAX BORDEN, JR., Jacksonville, Fla.
WILLIAM EHARD BUERK, Columbus, Ohio.
HARRY CANTEY, JR., Camden, S.C.
AL CONVERS CHURCH, Tallahassee, Fla.
GEORGE ALBERT DANDO, Augusta, Ga.
PHILIP EDWARD DUCHSCHERER, Buffalo, N.Y.
HENRY PRITCHARD EVANS, Alhambra, Calif.
CARL READ FILMER, Atlanta, Ga.
HARRY RICHARD HALLORAN, Philadelphia, Pa.
I CHEN HUANG, New York, N.Y.
MASON HILL KINCH, Urbana, Ill.
WILLIAM DAVIDSON LEAHY, Cochabamba, Bolivia.
LAURENCE PATTON MAINS, Philadelphia, Pa.
JOHN MAXWELL MCCANN, Kansas City, Mo.
PAUL JONES MCCLURE, Chattanooga, Tenn.
THOMAS CLAYTON NORTH, Zelienople, Pa.
HENRY ALBERT PFISTERER, New Haven, Conn.
JOE THEODORE RICHARDSON, Denver, Colo.
GEORGE EARL ROBINSON, Chicago, Ill.
JOHN JOSEPH SCHEUREN, JR., Boston, Mass.
DALTON BACON SHOURDS, Gulfport, Miss.
JOSEPH HARRISON SNYDER, Richland, Wash.
RAMASWAMI SRINIVASAN, Madras State, India.
ERNEST STOKES, Omaha, Nebr.
MAURICE ETHELBERT SUHRE, Rolla, Mo.
FRIEDRICH WILHELM HEINRICH AUGUST TOELKE, Karlsruhe Durlach, Germany.

Applying for Associate Member

CHARLES WILLIAM BARENFANGER, Shumaker, Ark.
GERSON BONNETT, Baltimore, Md.
DATTATRAY GANESH DHAVALIKAR, Ahmedabad, India.
ABDEL FATTAH SALIH DIWAN, Alexander, Egypt.
JOSEPH ANTONY DONOVAN, Chicago, Ill.
EUGENE VICTOR DOTTER, Pittsburgh, Pa.
REX LAVERNE EBERLINE, Los Alamos, N. Mex.
GENE RUTLEDGE EICHENBERGER, Omaha, Nebr.
JULIAN PITTS HINTON, Knoxville, Tenn.
JAMES JOSEPH KEATING, New York, N.Y.
LOUIS HALBERT LARSON, Honolulu, T.H.
HOWARD JOSEPH MCGINNIS, Chicago, Ill.
WILLIAM WILLSON MCMAHON, Little Rock, Ark.
NAJAH HASEEB NABULSI, Logan, Utah.
ELMER VIRGIL NOONER, Dallas, Tex.
DONALD CHARLES OGDEN, Dillsburg, Pa.
BENJAMIN HUR PLOWGIAN, Omaha, Nebr.
EUGENE WYATT RIPLEY, JR., Charleston, W. Va.
JACK SMITH, Augusta, Me.
GEORGE IRVING SPOONER, New York, N.Y.
GERALD BOYD SWANSON, Kansas City, Mo.
HERSCHEL HATHAWAY VARNEY, Kansas City, Mo.
DEZSOE VASARHELYI, Seattle, Wash.
ENRIQUE EMILIO VIVONI, JR., Aguirre, Puerto Rico.

Applying for Junior Member

FRANCISCO NORONHA AFONSO, San Francisco, Calif.
JOSEPH HERMAN ALBIEZ, New York, N.Y.
ROBERT KENNETH BEACH, New York, N.Y.
DUANE ELDON BLUNT, Ann Arbor, Mich.
HENRIQUE BRANDAO CAVALCANTI, Rio de Janeiro, Brazil.
JOHN CALEB CHILDS, SR., Towson, Md.
WALTER EWALD EHLERS, San Antonio, Tex.
HENRY FUSILLO, San Francisco, Calif.
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ROBERT RITCHEY HARVEY, Chicago, Ill.
MALCOLM DAVID HORTON, Los Angeles, Calif.
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JAMES ALTON HUNTER, JR., Dallas, Tex.
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IRVING KORNFELD, Berkeley, Calif.
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LAWRENCE ALBERT MULLNIX, Ventura, Calif.
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AIYAR B. SANKARASUBRAMONIA, Cochin State, India.
DAN MOODY WILLIAMS, Austin, Tex.
ROBERT FREDRICK WITTMAN, St. Paul, Minn.
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[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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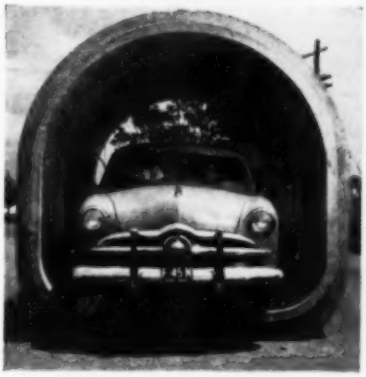

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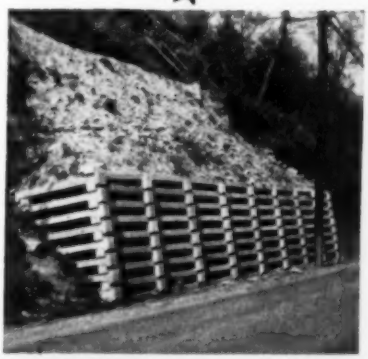

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2 AIR-ENTRAINING AGENT

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3 ALTIMETERS FOR MAPPING

Wallace & Tiernan—The successful use of altimeters transported by helicopter for vertical control of multiplex mapping is described by Col. R. R. Robertson in "Altimeters as used by the 30th Engineers for Mapping." The two-base method proved best and bases were separated as much as 30 miles horizontally and 7,000 ft vertically. Altimeter runs included 69 points of known elevation which were checked within 8 ft. Criteria for satisfactory altimetry conditions and for accepting altimetry elevations are given.

4 AUTOMATIC BACKWASH FILTER

Hardinge Co., Inc.—has just released a revised Bulletin, No. 46-A, covering the automatic backwash rapid sand filter. The filter has a compartmented sand bed and a traveling backwash mechanism which cleans one compartment at a time, while the rest of the filter bed operates normally. No shut down or change-over is necessary for backwashing. The catalog includes recent improvements in the filter, as well as new installation pictures and operating data. The following applications are discussed: industrial and municipal water supply, paper mill "white water" recovery, sewage and industrial waste treatment.

5 AUTOMATIC WATER GATES

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6 BITUMULS—TYPES AND USES

American Bitumuls & Asphalt Company—has a 24-page, two color booklet, "Bitumuls for Maintenance" which is a fully-illustrated, valuable guide to modern methods, materials and equipment for the repair and maintenance of existing pavements. It covers the use of various types of emulsified asphalts with a wide range of aggregates.

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8 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" catalog B-3 explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

9 BRONZE CASTING ALLOYS

American Manganese Bronze Company—A 50-page edition of the "Reference Book on Bronze Casting Alloys" gives general information on composition, characteristics, and applications of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

10 BUCKET LOADER

Barber-Greene Company—An 8-page, two color booklet describes the Model 82A crawler mounted bucket loader which has a truck loading capacity of 3 cu yds per min. This loader, in addition to its most common application of loading trucks from stockpiles of building aggregates, coal, slag or similar materials, can also be equipped with several varieties of screen for simultaneous loading and screening, can do light stripping or excavating work and can also be combined with their bituminous mixer to make a traveling asphalt plant.

11 BUSINESS AND TECHNICAL GUIDE

McGraw-Hill Book Co.—offers a 1953 guide to practical, expert information on many business and technical subjects. The catalog contains clear, concise descriptions of more than 2,000 books written by leaders of business, industry and research. In it there is an up-to-date listing of books that give the facts—experience—data—needed in solving your particular problems.

12 CAST-IN-PLACE PILES

Eastern Concrete Pile Co., Division of C. L. Guilf Construction Co., Inc.—has a folder on COBI cast-in place concrete piles. It illustrates how the piles are driven, poured, and tested. The corrugated spiral shell is driven by a pneumatic mandrel expanded with 125-psi pressure. The company points out that the piles screw themselves into the ground, resisting both settlement and uplift.

13 CAST IRON PIPE

Cast Iron Pipe Research Assoc.—A brochure, revised in 1950, gives general specifications, weights and dimensions of standardized mechanical joint cast iron pipe, fittings and accessories for water and gas. Tables show weights and dimensions for pipe centrifugally cast in metal and sand-lined molds and pitcast pipe.

14 CAST IRON PIPE

Warren Foundry & Pipe Corp.—has a general catalog showing weights, dimensions, description, etc., of bell and spigot, flange, flexible joint and mechanical joint cast iron pipe and fittings together with standard specifications for same.

Mail This COUPON To-day

CIVIL ENGINEERING Date .....
33 West 39th St., New York 18, N. Y.

Please have the literature indicated by the circled Catalog Digest numbers in the April 1953 issue sent to me without obligation.

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151	152*	153	154	155	156	157	158	159	160	161	162	163	164	165
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NOT GOOD AFTER May 15, 1953, for readers in the U.S., but requests will be accepted to June 30, 1953, from readers outside of this country.

There are 170 Digest items on pages numbered 108 to 126. Read all items for the literature of interest to you.

Use This Free Service—Mail The Coupon To-day

CATALOG DIGESTS

15 CHEM-O-FEEDERS

Proportioneers, Inc.—Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

16 CHURCH CONSTRUCTION

Timber Structures, Inc.—Eight pages, in full color with typical specifications and illustrations, show how traditional beauty with modern structural design become possible with churches of engineered timber.

17 CLARIFIERS

Hardinge Co., Inc.—The 12-page equipment Bulletin 35-C, gives a complete description and specifications of the Hardinge beam-type, circular clarifiers, center-column type, circular clarifiers, and rectangular clarifiers for skimming and sludge collecting. It also describes Hardinge digesters, automatic backwash sand filters, flocculating equipment and Ruggles-Coles rotary dryers. It covers stream pollution problems encountered by practically all industries which have a waste disposal problem.

18 CLARIFIERS

Infilco Inc.—Bulletin 850-A describes how the "Cyclator" is designed to combine in one unit all functions, both chemical and physical, for complete treatment of a wide range of industrial wastes, especially those containing large amounts of light suspended solids or those which produce voluminous sludges.

19 CONCRETE ADMIX

American Bitumuls & Asphalt Company—A 4-page leaflet, "Pittsburgh Testing Laboratory Report on Hydropel, An Integral Admix for Waterproofing Concrete" as compared to other admixes is offered. Reproductions of the actual test reports from this independent laboratory, combined with explanatory graphs, charts, photographs and summaries, show the superiority of Hydropel concrete in resistance to water absorption.

20 CONCRETE CONSTRUCTION ACCESSORIES

Superior Concrete Accessories, Inc.—Catalog 500 has 56 pages on accessories for concrete construction. Form ties and clamps are grouped by class of construction; for ordinary foundations, for water tight walls, for engineering structures and for architectural concrete. There is also a section devoted to special products often required in concrete construction. Tables of concrete pressures in forms at summer and winter temperatures, recommended safe spacings of form ties, grouped by sizes of form lumber and safe tie capacities are given in an insert at the back of this catalog.

21 CONCRETE CRIBBING

Universal Concrete Pipe Co.—An 8-page folder deals with concrete cribbing, tells where it is used, its principal advantages, shows typical wall sections, specifications and installation instructions.

22 CONCRETE DRILL

Pennsylvania Drilling Company—offers literature describing their Model E core drill designed to drill holes from 1/2 in. to 4-1/2 in. diameter through the use of various sizes of diamond bits and core barrels. Holes may be drilled at any angle, through practically any material such as reinforced concrete, marble, brick and glass. The drill is portable and has been designed to do extremely fast drilling for the installation of pipe lines and electrical conduits through masonry walls, floors and ceilings.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

Alabama Industrial Plant SAVES $5,000 with Koppers Pressure-Creosoted Posts

NOT long ago, an industrial concern decided to erect a 4,600-foot fence around its Alabama plant area. The bid received on a conventional chain link fence with steel posts embedded in concrete was $15,654.14. When they checked with Koppers they found that they could save $5,000 by using Koppers pressure-creosoted posts.

Needless to say, they installed pressure-creosoted posts. No concrete was needed—the posts were set directly in the ground. The link fence, supported by heavy wire, was easily attached to the strong, sound wood. They were so pleased with their chain link fence on pressure-creosoted posts that they have installed a similar fence at another plant.

Koppers pressure process forces creosote deep into the wood ... gives it long-lasting service for years and years. In fact, Koppers posts are known as 30-year posts. They are available in sawn or rounds in almost any size.

For further information, write your nearest Koppers Office.

KOPPERS COMPANY, INC.
Dept. CEW-43
Pittsburgh 19, Pa.

KOPPERS **PRESSURE-TREATED WOOD**

YUBA PLACER DREDGE DIGS, TREATS, STACKS 18,000 TONS GRAVEL DAILY...

This placer dredge with 18 cu. ft. buckets digs to 125' below water, averages better than 22 hours running time daily. Intricate treatment equipment on board limits digging to only 18,000 tons of gravel per day. For sand and gravel digging only, an 18 cu. ft. YUBA dredge can produce as much as 40,000 tons daily.

5¢ Per Ton

YUBA gold dredges of this type can be converted readily to produce and size gravel at total operating costs substantially under 5¢ a ton. One big advantage—they float in their own ponds and excavate gravel without lowering surrounding water levels.

Long Operating Life

With YUBA dredges you get both low production costs and long operating life—many YUBA dredges are operating efficiently after 25 years or more of rough service.

Consult YUBA NOW. We will design and build a new dredge to fit your ground; or help you find a used dredge, and move, redesign and rebuild it. Wire, write or call us—no obligation, of course.

Profusely illustrated, 40-page brochure, "YUBA Dredges," yours for the asking.

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CABLES: YUBAMAN, SAN FRANCISCO SHAWDARBCO, LONDON

63

CATALOG DIGESTS

23 CONCRETE FLOOR REPAIR MATERIAL

The Master Builders—A 6-page illustrated folder tells how Masterquick, a combination of graded metallic aggregate and asphalt makes possible easy, fast patching and resurfacing of worn concrete floors, increases the life of repairs by overcoming the problem of early breakdown of feather edges under traffic impact, permits the use of a thin patch—from 1/4 in. down to a feather edge, bonds effectively to old surface and produces a spark-resistant floor. Folder includes complete pictorial directions.

24 CONCRETE PAVEMENT DESIGN

Portland Cement Association—An 86-page edition simplifies and expedites design procedure for roads and streets carrying all classes of traffic. Eighteen pavement design charts have been reduced to four covering a somewhat wider range. This manual for the practicing engineer includes design charts for tiebars and dowels, an expanded section on subbases, two pages of joint details and a simplified procedure for determination of "controlling wheel load."

25 CONCRETE PIPE

Lock Joint Pipe Company—has a catalog covering the design and manufacture of all types of Lock Joint concrete pressure pipe and a pamphlet giving complete instructions for the installations of all types and sizes of the pipe. Both pamphlets are liberally illustrated with photographs and technical drawings.

26 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

27 CONCRETE PIPE HANDBOOK

American Concrete Pipe Assoc.—A handbook contains 384 pages on the manufacture and use of concrete and reinforced concrete sewer and culvert pipe. Discussion of Marston's Theory and maximum and minimum allowable depths of fill is presented along with examples and tables. Useful hydraulic data and information on jacking pipe lines is given. A thorough, comprehensive discussion of the use of concrete pipe in sewers and culverts is included. Appendix contains A.S.-T.M. and AASHO specifications. Price $4.00.

N. B. There is a charge for this book. Make checks payable to The American Concrete Pipe Association.

28 CONCRETE WALL FORMS

Symons Clamp & Mfg. Co.—All the latest information and improvements in the Symons forming system is explained in detail in a 44-page catalog issued by the company. Illustrations show how simply and easily the forming system operates and picture actual construction where the forms have been used. Blueprints and complete specifications are given with material necessary, time required and cost figures on actual jobs. Catalog also contains detailed information on Symons safety shores and column clamps.

29 CONSTRUCTION DATA HANDBOOK

A. C. Horn Company—A 106-page Horn Construction Data Handbook is offered. Each product is listed as to description, use, covering capacity, color and packaging. Included in the catalog are construction details, and many tables and charts on weights and measures.

30 CRANE-EXCAVATORS

Wayne-Crane Div., American Steel Dredge Co., Inc.—A catalog, illustrating the heavy-duty line of 1/2 yd crane-excavators, has been published. Numerous features of all three models—crawler, truck and wagon—are shown in this descriptive catalog. These include the deck machinery layout, self-leveling chassis, oversize 20 in. clutches, large modern cab and right angle drive mechanism. Complete specifications and operating data are included.

CATALOG DIGESTS

31 CRAWLER TRACTOR

Allis-Chalmers Manufacturing Company—A catalog on the HD-20 diesel-powered hydraulic torque converter drive crawler tractor features sectional views of the complete tractor and components. Weighing approximately 41,000 lbs, the HD-20 is the largest crawler tractor built. The engine delivers 175 net horsepower at the flywheel.

32 DEMINERALIZATION

The Permutit Company—Bulletin 3803 called "Demineralization Including Silica Removal by Ion Exchange," was designed to help explain one of the newest roles that ion exchangers are playng in industry. This 28-page booklet explains the chief applications, principles of operation, design features, advantages and recommendations and specifications of its demineralizing and silica removal apparatus and synthetic resins.

33 DETECTOR-RECORDER

Taller & Cooper, Inc.—A booklet describes the Carbon Monoxide Detector-Recorder, which automatically registers variations as small as five one-hundredths of a part of CO in ten-thousand parts of air. The detector-recorder conducts continuous sampling and chemical analysis of air in mines, tunnels and other subsurface structures, as well as in garages, bus depots and industrial buildings where personnel safety requires constant supervision of toxicity hazards. The device sounds an alarm when any analysis shows undue concentration of carbon monoxide, and also keeps a continuous chart of analysis results.

34 DIAMOND BITS

Sprague & Henwood, Inc.—Bulletin No. 320 has sixteen large fully-illustrated pages containing detailed information regarding a complete line of diamond bits for core drilling, blast-hole drilling, etc. Information is given, also, regarding Sprague & Henwood's modern manufacturing facilities, their complete line of drilling machines and accessory equipment for core drilling and soil sampling, and their world-wide business in contract diamond drilling. The latter includes exploratory core drilling, foundation testing, grout hole drilling and pressure grouting.

35 DIAMOND CORE DRILL

Pennsylvania Drilling Company—offers Bulletin A-108 describing their Model JE core drill which is designed for prospecting mineral deposits and coal seams; for testing subsurface conditions; and drilling pressure grout holes.

36 DIESEL CRAWLER TRACTORS

International Harvester Company—presents individual product catalogs covering each of the five International industrial diesel crawler tractors, TD-6, TD-9, TD-14A, TD-18A, and TD-24. Two of the above models are also available with carbureted engines, T-6 and T-9. A special catalog illustrating crawler tractors in pipe line operations can be obtained upon request.

37 DIESEL POWER UNITS

International Harvester Company—Information on six models of International diesel power units, the UD-6A, the UD-9A, UD-14A, UD-16A, UD-18A, and UD-24 is contained in a catalog entitled "International Diesel Engines and Power Units." A second catalog entitled "International Gas Gasoline or Distillate Engines and Power Units" covers the five International carbureted power units, U-1, U-2A, U-4, U-6, and U-9. Also available is a catalog illustrating International power units in oil field pumping operations.

38 DISTRIBUTORS

Bucyrus-Erie Co.—A two-color, 12-page stuffer, "A 5-minute Sketch of Your Bucyrus-Erie Distributor" outlines the services contractors can expect from distributors along with the reasons why distributors are qualified to perform them.

A new beach is flowing through this **NAYLOR PIPE**

For moving sand, gravel, water, air or what have you, you can always depend on Naylor pipe. Though light in weight, Naylor has the lockseamed, spiral-welded structure that gives the extra strength, leak-tightness and safety needed for heavy duty service.

Naylor pipe is easy to handle and install. When used with the Naylor Wedge-Lock coupling, lines can be quickly assembled or knocked down, with high salvage and re-use value.

Sizes range from 4 to 30 inches in diameter and thickness from 14 to 7 gauge. Write for Bulletins No. 507 and No. 513.

NAYLOR PIPE COMPANY
1281 East 92nd Street, Chicago 19, Illinois
New York Office: 350 Madison Avenue, New York 17, New York

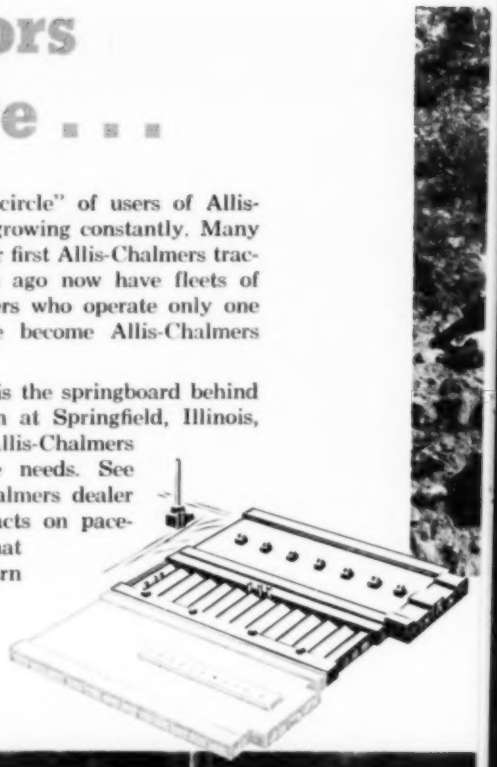
There's more to tractors than meets the eye . . .

The real "pay-off" value of any tractor to its owner is how it measures up to the standards set by today's modern production methods.

To meet these needs, Allis-Chalmers started from scratch and built *a line of tractors with a future*. Thousands now have been tested and proved on the toughest proving ground of them all, actual jobs, and they have more than measured up to expectations. Owners have found that these tractors set new standards of performance . . . that they give greater output with less down time . . . plus more profit, whether pulling, pushing, digging or dozing. Operators have discovered new ease and comfort in operation, too; and mechanics say these are the easiest-to-service tractors that they have ever worked on.

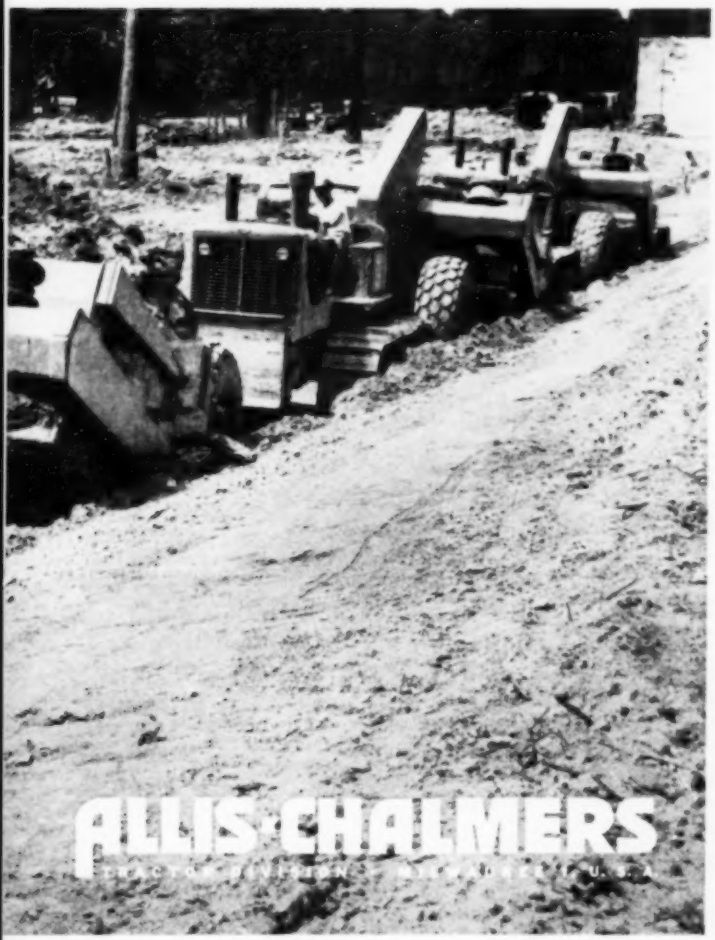
Yes, the "family circle" of users of Allis-Chalmers tractors is growing constantly. Many users who bought their first Allis-Chalmers tractor only a few years ago now have fleets of them, and many others who operate only one or two tractors have become Allis-Chalmers boosters.

This acceptance is the springboard behind a big plant expansion at Springfield, Illinois, which will enable Allis-Chalmers to meet *your* future needs. See your nearby Allis-Chalmers dealer now for the inside facts on pace-setting tractors that measure up to modern production methods.



From haul road to highway to heavy construction . . . wherever big production is essential to the job, this big HD-15 has more than proved its worth. With 109 drawbar hp. and 27,850 lb. weight, it works quickly, efficiently as a dozer, tractor-shovel, puller or pusher.

This 72 drawbar hp., 18,800-lb. HD-9 is making friends in every field because its power and weight make it ideal for dozens of today's jobs. And, operators can gain up to 25 percent more production on short dozing jobs because they can go from any forward to any reverse speed with just one shift.



The 40 drawbar hp., 11,250-lb. HD-5 is a versatile jack-of-all-trades for fleet owners as well as one-man operations . . . with hydraulically controlled Tracto-Shovel, it's equally useful loading bulk materials, dozing, digging basements, dozens of other jobs.

Here's real tractor teamwork . . . four HD-20's in a "train" — three pulling scrapers, one pushing — all working together for big production. With torque converter drive, they synchronize speeds at contact . . . automatically load at the fastest speed that job conditions permit, with less strain on operators and equipment. With 175 engine hp. and 41,000 lb. weight, the HD-20 is today's new yardstick of crawler tractor performance.

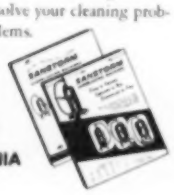
SANSTORM IT!

shortcut your costs!

More and more construction companies are cleaning steel fabrications, forms, equipment cheaper and quicker with Sanstorms—the most famous machines in sandblasting.

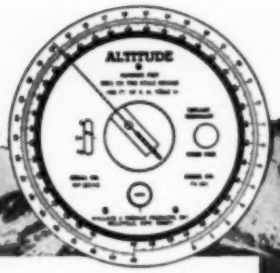
Because they won't foul, will use any abrasive the job requires—*gentle* to smooth off or *tough* to skim off heavy scale—you'll get big savings with a Sanstorm.

Write Today about your cleaning chores and Sanstorm blastcleaning experts will shoot back recommendations without cost or obligation to solve your cleaning problems.



SANSTORM
MANUFACTURING COMPANY
P. O. BOX 1173 - D, FRESNO, CALIFORNIA

RUGGED COUNTRY *Requires* **RUGGED ALTIMETERS**



Whether you're surveying rough terrain or gentle slopes, it's nice to know that your precision altimeters are rugged and durable enough to withstand severe shocks and vibrations. This security is yours with W&T Sensitive Altimeters.

Consider particularly the W&T Sensitive Altimeter Type FA-181 — an instrument in which construction and precision meet the exacting requirements of military service. The Type FA-181 is aluminum cased and has a latched metal lid for protection under all climatic conditions. Several standard ranges are available. The −1000 to 6000 foot range, for example, is readable to one foot — with sensitivity of one part in 8000. A desiccant (with a condition indicator) is included to absorb moisture which may enter the case. The Altimeter is compensated for temperature changes and readings do not require correction.

Important features of the FA-181 as well as other W&T Altimeters include:

SELF BALANCING PRINCIPLE. No adjustment or setting is required. There is no lag.

CALIBRATION. Scales are individually drawn for each mechanism and require no correction.

DURABILITY. The mechanism is simple and is shock-proof mounted within the instrument case.

PERFORMANCE. W&T Altimeters rival the accuracy of the finest laboratory standards and performance stated in the specifications is guaranteed.

An altimetry manual is furnished with every W&T Altimeter. Also available is the W&T Palmer Altirule, a graphic computer for calculating elevations of field stations without computation when using the Two Base Method of Precise Altimetry.

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PRODUCTS, INC.
ELECTRICAL MECHANISMS AND PRECISION INSTRUMENTS
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A-93

CATALOG DIGESTS

39 DOCKS, WHARFS AND PIERS

De Long Engineering & Construction Co.—Brochure describes the fabricating, towing and erecting operation of the De Long dock. This steel dock fabricated in efficiently operated fabricating or ship building plants or yards in various parts of the world and towed to site of final location is erected in a matter of several days ready for berthing ocean-going ships. Permanent or temporary erections. Brochure illustrates installations of 50 ft by 1000 ft dock for army north of arctic circle and permanent 82 ft by 1130 ft ore and cargo handling dock on Orinoco River, Venezuela.

40 DOORS

The Kinnear Manufacturing Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features, and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 75, it gives information on installation clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

41 DOUBLE-X MECHANICAL JOINT PIPE

The American Cast Iron Pipe Company—manufactures Mono-Cast centrifugal pipe in diameters 3 in. to 48 in. inclusive. Among the joints offered with this pipe is the American Double-X Mechanical Joint. A booklet describing this product gives dimensions, weights and metal thicknesses. The booklet contains 44 pages and is illustrated.

42 DRAFTING PENCILS

Eberhard Faber Pencil Company—offers a descriptive and illustrated pamphlet describing the Microtomic drafting pencil and its many outstanding features. The pamphlet will be helpful in acquainting the reader with what should be expected of a superior drafting pencil and lists features found only in the Microtomic. A sample pencil will be included provided degree preferred is specified.

43 DRAWING INSTRUMENTS

Borden and Riley Paper Co., Kern Drawing Instrument Division—A brochure offers a description of the precision drawing instruments, kits and individual pieces, manufactured by the renowned Kern & Co., Ltd. of Aarau, Switzerland. The brochure is profusely illustrated and reflects the latest technical advances that are embodied in every Kern kit and instrument.

44 DREDGES

Yuba Manufacturing Company—has prepared a 42-page booklet describing Yuba bucket line dredges and their use in the placer mining and excavating industries. A copy of the booklet will be mailed upon request and extra copies will be furnished to libraries and universities particularly interested.

45 EARTHMOVERS

Allis-Chalmers Manufacturing Company—A catalog "On the Job with Allis-Chalmers Rubber-Tired Earthmovers" is a 16-page pictorial catalog illustrating job pictures of the TS-300 and TS-200 motor scrapers, and the TW-300 and TR-200 motor wagons. Brief descriptions are given on each.

46 ECHO DEPTH RECORDER

Bludworth Marine, Div. of National-Simplex-Bludworth, Inc.—A specification sheet describing Model ES-123 Supersonic Echo Depth Recorder is offered. This instrument provides a permanently recorded graph of underwater contours as well as an indication of the constituency of bottom materials. Underwater survey groups, dredging companies, bridge builders and underwater pipeline companies will find this equipment most interesting.

47 EFFECTS OF CALCIUM CHLORIDE

Solvay Process Div. Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

48 ELEVATED STEEL TANKS

Pittsburgh-Des Moines Steel Company—offers a 20-page brochure, "Modern Water Storage in Elevated Steel Tanks." The comprehensive publication includes sections providing technical data, dimensional tables and installation views of the company's double ellipsoidal, obloidal, torosegmental bottom, radial cone bottom and hemispherical bottom elevated steel tanks. Other sections of the brochure are devoted to accessory equipment, the use of new tanks on old towers, factors to consider in choosing an elevated steel tank, and many installation views.

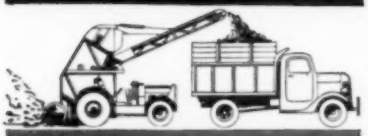
49 EQUIPMENT

Austin-Western Company—A 12-page catalog, AD-2146, covering the company's line of equipment is available. This includes descriptions and pictures of the various sizes of power graders and their attachments, street sweepers, 3-wheeled and tandem rollers, the Badger convertible shovel and the complete line of crushing, screening and washing equipment.

Turn to page 108 and order your literature.

longest trucks

highest trucks



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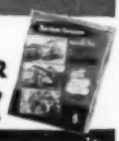

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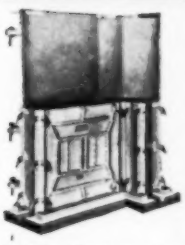
Save manpower time and material



When placing concrete, use this nationwide Form Rental and Engineering Service to increase profits, reduce costs.

Standard units of Economy Forms fit most jobs. But where needed, special forms can be built to specification.

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- Tanks — Circular and Rectangular
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ECONOMY FORMS
. metal forms for concrete construction

CATALOG DIGESTS

50 ENGINEERING INSTRUMENTS

W. & L. E. Gurley—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Description and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

51 EXCAVATORS

Bucyrus-Erie Co.—A two-color, 16-page stuffer, "In Excavators Big Output Depends on Design," explains the advantages of individually designed excavators. The booklet tells why dipper size, power, weight and all other factors must be perfectly matched to attain highest output at lowest cost.

52 EXCAVATORS AND CONVEYORS

Sauerman Bros., Inc.—Catalog A, "Power Drag Scrapers" describes long range-handling of earth, clay, broken rock and other bulk materials at low cost. Catalog C, "Stackline Cableway Excavators has 28 pages, telling you about a machine which digs, hauls, elevates, and automatically dumps all in one motion. Catalog G, "Tautline Cableways" shows how they are used to hoist and convey 1-ton to 25-ton loads on bridge, dam and filtration plant construction jobs. Catalog J, "Scraper Buckets" is a detailed summary of standard types plus some specially designed buckets used with drag scrapers.

53 FIBRE FORMS

Sonoco Products Company—A 4-page brochure which describes the use of fiber forms for round concrete columns is offered. It also illustrates many different uses and gives sizes of the forms.

54 FILTER EQUIPMENT

Infilco Inc.—Bulletin 1560-B includes technical data and description of the Stellar Filter for filtering through diatomite or other filter-aid without the use of coagulants. The Stellar Filter is designed to treat 300 gph to several thousand gph.

55 FILTER PLANT GAUGES

Simplex Valve & Meter Co.—A complete description of the Simplex filter plant gauges is contained in Bulletin No. 1000. This contains illustrations and dimensional data on the many forms of gauges used in filter plants such as rate of flow, loss of head, elevation, wash water and sand expansion units. This bulletin should be a part of the engineer's catalog file.

56 FINISHING MACHINES

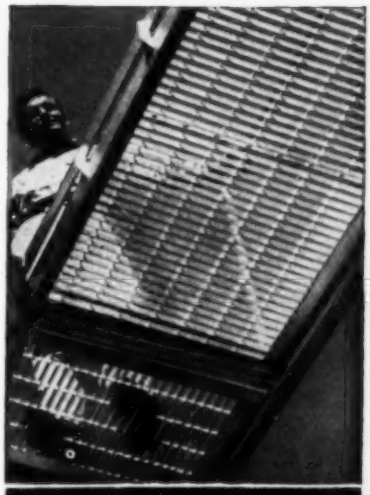
Flexible Road Joint Machine Company—Bulletin N-14, "Flex-Plane Bridge and Elevated Highway Concrete Finishing Machines," is a 20-page catalog describing the use of mechanical finishing machine equipment on concrete bridge and elevated highway decks, complete with photographs of actual job installations, together with suggested specifications for supporting finishing machines.

57 FLAT BASE PIPE

The Universal Concrete Pipe Co.—has a folder on flat-base pipe which is available in a wide variety of standard sizes. Flat-base pipe simplifies construction of culverts, pedestrian underpasses and cattlepasses, utility galleries and manholes. Advantages are listed, construction details and illustrations are included.

58 FLOODLIGHTING PLANS

General Electric Company—NEMA-authorized engineering information. Designated as bulletin GET-1284C, the publication includes complete layouts and specifications for all types of recreational facilities, including lighting diagrams for swimming pools, tennis, baseball, golf-driving ranges, racetracks, and the like.



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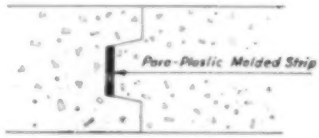

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CATALOG DIGESTS

59 FLOOR GRATINGS

Borden Metal Products Co.—A catalog containing technical information on how to select, design, purchase and install floor gratings, safety steps, floor armor is offered. Safeload tables, step-by-step procedure for ordering, planning and checking, etc., is included.

60 FLOOR SURFACE

The Klemp Metal Grating Corporation—has just printed a catalog on their patented floor surface armor—Hexteel. It is directed to plant superintendents, plant engineers and maintenance men, who are responsible for the condition of the floors in their particular industry. The catalog is fully illustrated with application and installation photographs. The Klemp Hexteel Catalog is technically written and describes how Hexteel can be laid on concrete, wooden, or wood brick floors.

61 FLUORIDATION

Proportioneers, Inc.—Bulletin SAN-9 gives the complete story on the feeding of fluorides for the reduction of dental caries. It explains the methods of feeding sodium silico-fluoride and hydrofluoric acid under pressure. Special attention is given to the accurate control of feeding in strict proportion to the flow. Equipment is described for feeding into pressure line.

62 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

63 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc. has literature on the construction of difficult and unusual foundations, description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations, Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

64 FOUNDATION PIPE

Albert Pipe Supply Co., Inc.—An 8-page brochure describing caissons, pipe piles, pipe shells and fittings, sets forth valuable tables on piling, points, sleeves and shoes as well as useful extracts of amendments to the New York City Building Code as it applies to this commodity.

65 GEAR CATALOG

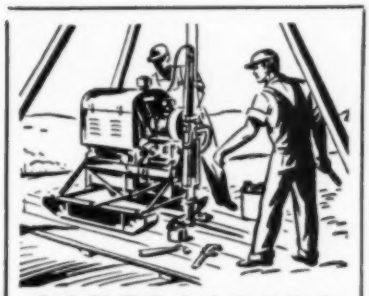
The Earle Gear & Machine Co.—A 20-page, amply illustrated catalog, "Earle Gears", containing a wealth of gear information, is now available. Data incorporated in this catalog include: descriptive material and blueprint dimension drawings of spur, bevel, helical and worm gears; gear ordering information; and useful formulae. Non-metallic gears, racks, sheaves, sprockets and special machinery are also pictured and described.

66 GRADATION CONTROL UNITS

Barber-Greene Company—A 4-page, two color booklet, describes the Model 863 and 864 gradation control units for the Model 840 (15-35 ton per hour) asphalt plant. These gradation units provide complete 3 or 4 bin separation and storage of aggregates after drying. These are the first units of this type to be available in an asphalt plant of this tonnage capacity.

67 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.



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CATALOG DIGESTS

68 GRID ROLLER

Hyster Company—An entirely new method of economical bituminous highway salvage and repair is now possible by means of the Grid Roller. The tool is designed for towing behind a motor grader or tractor and is based on the latest techniques and knowledge gained from actual field experience in the past three years. The Grid Roller solves the problem of salvaging bituminous roads, regardless of age, by its three-way action. It disintegrates the old mat material, compacts the base and rolls the new surface. An illustrated catalog describing the features and applications in detail is now available.

69 GUNITE

Pressure Concrete Company—has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories, and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and much other data. A new leaflet just published illustrates pressure grouting to dams.

70 HEAVY DUTY MOTOR OILS

Standard Oil Company (Indiana)—A 12-page illustrated booklet covering the history and development of Standard's heavy-duty motor oils is available. This bulletin reviews the performance requirements of heavy duty motor oils and defines the new A.P.I. service classifications.

71 HIGHWAY STRUCTURES

American Association of State Highway Officials—offers Standard Specifications for Highway Bridges, 6th edition, 1953. In keeping with policy of frequent revision in order to incorporate all current developments, the Committee on Bridges and Structures of the American Association of State Highway Officials has completed the new volume published by the Association. This book is accepted throughout the world as a leading treatise on highway structures. Every design engineer should have this publication. Price is $4.00 each.

N. B. There is a charge for this book. Make checks payable to American Association of State Highway Officials.

72 HOISTING MACHINERY

Superior-Lidgerwood-Mundy Corporation—Bulletin H-414 describes and illustrates a full range of steam, electric, gasoline and diesel-powered hoisting machinery built in standard sizes. Complete information given relative to drum sizes, line pulls, horsepower ratings, weights, etc. This bulletin also includes boom swinging gears and special data—how to figure rope capacities of drums, how to figure carpuller and capstan loads, loads which can be handled by hoists using various parts of load lines, and various lead lines.

73 HOT PROCESS WATER SOFTENERS

The Permutit Company—Bulletin 2341 describes and illustrates new hot process water softeners. This equipment is especially designed to condition boiler feedwater so as to protect tubes and drums against scale and corrosion and inhibit caustic embrittlement.

74 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

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CATALOG DIGESTS

75 HYDRAULIC DATA BOOK

Leupold & Stevens Instruments, Inc.—Interpretive data on water measurement and control is at your fingertips in the 144-page revised edition, in three parts: Float Wells and Instrument Shelters; Errors in Float Operated Devices; Hydraulic Tables; plus pages for notes and memorandums. Indispensable for the engineer with its wealth of information, tables, charts and illustrations. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.

76 HYDRAULIC TURBINES

James Leffel & Co.—Two new bulletins tell about recent Leffel hydraulic turbine installations. Bulletin 1085 describes the Leffel installation at the Bureau of Reclamation's new Anderson Ranch Dam, with photos, statistics, etc. Bulletin 1086 contains information on a Leffel turbine used in the expansion of TVA's Wilbur Dam, with photos, field test results, cross-section of installations, etc.

77 HYDROCRANE

Bucyrus-Erie Co.—A two-color, 16-page stuffer, "The Wise Buy Hydrocrane," emphasizes the extreme mobility and versatility of the truck mounted 3-ton Hydrocrane with ¾ yd clamshell or the dragshovel front-end called Hydrohoe. A few of these machines outstanding features are precise hydraulic control, telescoping boom, economical maintenance, easy operation.

78 INCINERATOR STOKERS

Flynn and Emrich Company—Bulletin No. 1501 describes a completely new design of automatic stoker for municipal and industrial incinerators. The bulletin describes clearly the design and operation of the simple, rugged and dependable incinerator stoker and test data is also included to prove its effectiveness.

79 INDUSTRIAL LINE

Johns-Manville—A 40-page catalog with descriptions, uses and sizes of the principal products in the J-M industrial line is available. It illustrates and describes various types of J-M industrial insulations, and also serves as a handy reference catalog for information on J-M asbestos-cement pipes, friction materials, electrical materials, packings, flooring and roofing.

80 JOINT FILLERS AND SEALS

Servicised Products Corporation—A catalog gives complete details and specifications on joint fillers, hot-poured Para-Plastic sealing compound, premolded Para-Plastic, molded rubber waterstops, corrugated closure strips, sewer joint seals, rail filler, Calk-Crete sealing compound, and safety stair treads.

81 LETTERING MACHINE

Ralph C. Coxhead Corporation—The Vari-Typer engineering lettering machine relieves draftsman from tedious hand lettering. The machine operates like a typewriter, but has instantly changeable type faces in different styles and sizes to meet the various needs of the tracing or bill of material. The carriage is designed to hold tracings as much as 6 ft or more in width. The type impressions are electrically controlled producing a uniform, sharp, black character so important to a good tracing. Mathematical symbols as well as draftsmen style lettering is available in the changeable type for cartridge.

82 LIGHT-WEIGHT PIPE

Naylor Pipe Company—has a bulletin presenting typical applications of Naylor pipe, tables on standard fittings and slip-on welding flanges, and how Naylor wedge-lock couplings speed connections by 4 simple steps. Photographs, diagrams and specifications are included.

83 MASONRY CEMENT

Lone Star Cement Corporation—A 16-page, illustrated booklet outlines the advantages of Lone Star masonry cement in simplifying the problem of obtaining uniformly high-quality mortar, as well as the economy of one rigidly standardized, ready-to-use cementing material instead of two, with no lime or portland cement to add, and no soaking or slaking. It provides timely information on soundness, low absorption, high water repellency and other factors contributing to durable, weather-resistant performance. Contains easily-read graphs showing effect of mix proportions on water retention, strength and absorption, effect of mixing time on water retention, etc., along with convenient reference tables for estimating quantities.

84 MEASURING FLUME

Thompson Pipe & Steel Company—Self-cleaning Thompson Parshall flumes give permanently accurate water measurement as described in a bulletin now available. The many advantages of the flumes are presented and one of the most complete tables on free flow discharge from Parshall flumes ever published is included. These tables enable you to read the amount of water flowing in any standard size Parshall flume with a throat width from 3 in. to 15 ft.

85 MEASURING TAPES & RULES

The Lufkin Rule Company—A 96-page catalog describes measuring tapes and rules for engineers that are manufactured by the company. Special measuring tapes used in mining and oil, as well as engineer's frame and case tapes, are covered. Not only are steel and woven measuring tapes described, but also the new Hi-Line non-metallic tape which is woven from the newest fibres developed by science.

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CATALOG DIGESTS

86 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describes mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

87 METRIC CONVERSION

Mayo Tunnel & Mine Equipment—has a wall chart which will be of great value to engineers who must frequently convert meters to feet-and-inches or vice versa.

88 MOBILE MIXING UNIT

Hetherington & Berner, Inc.—Bulletin MP-51, offers complete details on the Moto-Patcher, a mobile mixing unit designed for easier, more economical road and street maintenance. Photographs, specifications and a moto-patcher flow diagram are included.

89 MODERN CONSTRUCTION

Timber Structures, Inc.—Covering the construction field from schools to churches to warehouses, commercial buildings and industrial plants, this full-color booklet contains full information on all phases of building with timber.

90 MODERN SCHOOLS

Timber Structures, Inc.—Twelve pages in color give designs and uses of timber in classrooms, gymnasiums, libraries, multi-purpose rooms, field houses, grandstands, and other educational buildings and rooms.

91 MOTO-PAVER

Hetherington & Berner, Inc.—The Moto-Paver which provides a new and more efficient method for cold mix bituminous construction is described in Bulletin MP-49. Construction and operating features that make the Moto-Paver outstanding for dependable, economical performance are shown and a flow diagram and specifications are included.

92 MOTOR GRADER

The Galion Iron Works and Mfg. Co.—Catalog No. 375, on the Model 118 motor grader is available. Time-proved features are listed and a construction detail chart, sections on the Galion constant mesh transmission and accessories and attachments are included.

93 MOTOR GRADERS

Caterpillar Tractor Company—A booklet recently released "Grading Profits," features a detailed description of the advantages of Caterpillar motor graders. The 8-page booklet contains 22 illustrations which range from photos of Cat Motor graders in action to detailed cutaways of such parts as the transmission and control mechanism. The booklet also illustrates the variety of attachments the motor graders will take, such as a scarifier, bulldozer, Domor elevating grader, Domor road widener and snow plow.

94 MOTOR SWEEPER

Austin-Western Co.—An 8-page catalog, AD-2042, pictures and describes the Model 40 motor sweeper with its unique direct broom-to-hopper sweeping which makes unnecessary the conventional belt conveyor or squeegee elevator. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in the catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

95 NON-SLIP FLOOR PLATE

Alan Wood Steel Company—offers foot-safety facts in capsule form. An 8-page folder shows how to end slipping accidents and cut compensation insurance premiums with unique A. W. Algrip abrasive rolled steel floor plate. Included are construction details and advantages of this anti-skid floor plate; typical industrial, marine and commercial applications; fabricating data; sizes, weights and allowable loads per square foot.

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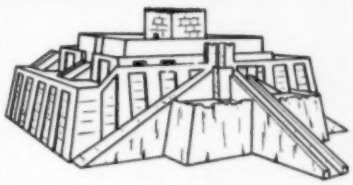

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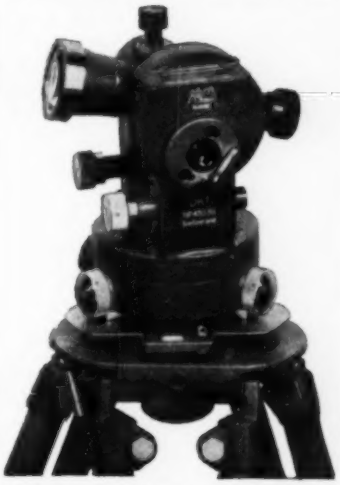

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CATALOG DIGESTS

96 OUTDOOR LIGHTING

General Electric Co.—Bulletin GEA-3640D, "Outdoor Lighting for Industrial Plants" contains many helpful suggestions for properly lighting plants. Adequate lighting of roadways, loading platforms, parking areas and property lines can easily be obtained with the luminaires and floodlights described.

97 PAVING TREATMENTS

American Bitumuls & Asphalt Company—A 28-page, two-color booklet describes in fully scenic photographic form and with basic tabular data the newest practice in step-by-step construction of surface treatments, armorcoats and penetration pavements with Bitumuls emulsified asphalt.

98 PENCIL SKETCHING

American Lead Pencil Co.—24 pages of helpful illustrated instructions on pencil sketching. Only 25c with two free Venus drawing pencils.

N. B. There is a charge for this book. Make checks payable to the American Lead Pencil Co.

99 PERMANENT TIMBER BRIDGES

Timber Structures, Inc.—An 8-page booklet, illustrating various types of bridges of timber construction, including deck arch, bowstring truss, composite deck, girder, and deck truss, presents the case for lasting, functional structures of engineered timber construction.

100 PILES

MacArthur Concrete Pile Corporation—A 4-page folder entitled "Foundation Piling of Every Type" giving description of various types of MacArthur piles and company engineering services is available and also a semi-technical 4-page folder for pile reference "Planned Foundation Piling for Foundation Construction." Therein is presented technical reasons covering the use of various types of foundation piles.

101 PILES

Raymond Concrete Pile Company—Standard and step-tapered piles are described in literature which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation—concrete, composite, precast, steel, pipe and wood piles; also caissons, underpinning. Domestic operations also include construction involving shore protection, shipbuilding facilities, harbor and river improvements, and cement-mortar lining of pipelines in place. Raymond's foreign services include every type of construction.

102 PILES AND CAISSONS

Western Foundation Corporation—An 8-page bulletin on concrete piles and caissons is offered. Services performed by Western Foundation are enumerated and seven types of cast-in-place concrete piles such as: the button bottom, concrete pedestal, compressed concrete and wood composite, are outlined in the catalog.

103 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—has just published a catalog, No. 81, containing descriptive information, engineering and test data on Monotube steel piles. It also includes numerous photos showing a wide range of job applications in various parts of the country. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: light weight, easy handling, speedy driving, economical field extensibility, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

104 PIPE CEMENT LINING

Centriline Corp.—A booklet describes the method of reconditioning pipe lines in place by placing a cement mortar lining on the inside surface which will stop leaks, corrosion and increases flow coefficients. This work can be done in pipe diameters from 4 in. to 144 in. with a minimum interruption of service.

105 PIPE LININGS

Pipe Linings, Inc.—"Tate Process," a 10-page illustrated, multicolor bulletin covers a method of lining smaller diameter water, oil, or gas pipe lines "in place". The service cleans corroded matter and tubercules from pipe walls and applies smooth cement-mortar lining.

106 PIPE PREFABRICATION

Albert Pipe Supply Co., Inc.—An 8-page brochure describing the company's modern and complete pipe prefabrication services, sets forth useful tables and list prices on many items.

107 PNEUMATIC GROUTER

Mayo Tunnel & Mine Equipment—Bulletin No. 13 illustrated the Mayo penumatic grouter which may be used for conventional cement grout, for injecting chemical emulsion for soil stabilization or it may be converted into a "pea shooter".

108 PORTABLE ASPHALT PLANTS

Hetherington & Berner, Inc.—Bulletin P-52 on portable asphalt plants is available. The design of the PA and PE type plants featured in this bulletin is so flexible that they can be adapted to provide dependable high production performance under almost any combination of conditions. Illustrations, features, dimensions, specifications, etc., are included.

109 POWER DISTRIBUTION

General Electric Company—offers a guide to modern plant electric power distribution practices. This large bulletin designated GEA-5900 explains in detail 12 ideas on industrial power distribution that will help maintain power continuity, reduce installation and operating costs, safeguard personnel and equipment, and plan a complete packaged distribution system. Each idea is developed by graphs, electrical diagrams, or photographs of equipment and installations.

110 POWER GRADERS

Austin-Western Co.—A 24-page catalog, AD-2112, pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

111 PRECISION-BUILT CEMENT FLOORS

Kalman Floor Company, Inc.—An illustrated 8-page catalog describes the Kalman process, a precision method of building in maximum hardness and density uniformly over complete floor areas. The laying of one of these granolithic cement floors in a typical plant shows in detail the under-slab preparation, preparation of proper-aggregate Kalman topping mix, absorption control, compacting, surfacing, troweling and curing.

112 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—An informative, 4-page brochure, combining a catalog and calculating chart, has been prepared. Pictured in four colors on the cover is the Berger Type R transit, one of the many instruments produced by the 81-year-old firm. On the center spread are photographs and code names for 12 types of Berger instruments, from an 18-in. dumpy level to a plane table alidade.

113 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—Complete specifications on the Berger "N" line of moderate-priced builders' instruments are included in an illustrated brochure now available. Companion line to the company's engineering, mining and astronomical instruments, the "N" line consists of a convertible transit-level, a 12-in. heavy-duty dumpy level, a service transit level (farm level) and a hand level.

114 PRECISION INSTRUMENTS

Berger Scientific Supplies, Inc.—39 precision drawing sets, triangles, protractor, T-squares, curves, slide rules and scales are illustrated and described in a brochure. The Berger drafting kit, which combines all necessary draftsman's instruments and supplies in one easy-to-carry case, is also illustrated.

115 PRESSURE-CREOSOTED PILES

Koppers Co.—A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

116 PROCESS OILS

Borne, Scrymser Company—has a brochure listing their principal products which may be segregated into two main classifications; process oils and industrial lubricating oils and greases. There is a separate section on recommendations for lubricating oils and greases and one on the use and application of industrial process oils.

117 PUMPS

Economy Pumps, Inc.—A 448-page data book, 4¼ in. by 8¾ in., with flexible binding, contains general information on centrifugal pumps, principles of pump engineering, general engineering data and selection tables on centrifugal, axial and mixed flow pumps. This book is priced at $3.00.

N. B. There is a charge for this book. Make checks payable to Economy Pumps, Inc.

118 PUMPS

A. O. Smith Corp.—Pumps of various types and capacities ranging from 50 to 5,000 gpm are described in three bulletins offered by the company. Completely illustrated, the bulletins include details of component parts as well as design and construction features which contribute to the long life and operating economy of the pumps. Features which are explained include the especially-designed Smith-built motors and the fabricated all-steel head of the pumps.

119 REALOCK FENCE

Wickwire Spencer Steel Division—The Realock fence catalog has all the information necessary to answer your questions pertaining to the protection of your residential or industrial property through the use of fence. It is well illustrated and shows many additional uses of Realock fence such as tennis court enclosures, baseball backstops, etc.

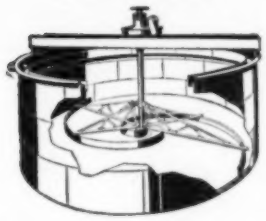
120 RENTING STEEL SHEETPILING

L. B. Foster Company—An expanded and up-to-date edition of the "Piling Catalog" comprehensively covers the use of steel sheet piling in the construction of all types of cofferdams as well as for other construction problems. Information on auxiliary Foster equipment such as pile extractors and pile hammers is included. Specifications for the interlocking piling sections, as well as corners and connections, of the three leading manufacturers of steel sheetpiling are presented. Data on the advantages of renting steel sheetpiling are given.

121 REPRODUCTION MATERIALS

Eastman Kodak Company—A booklet, "Modern Drawing and Document Reproduction with Kodagraph Reproduction Materials," discusses the advantages of photographic document reproduction materials and photographic equipment for microfilming purposes. It points the way towards better darkroom reproduction and techniques for use in drafting and engineering purposes.

THICKENERS

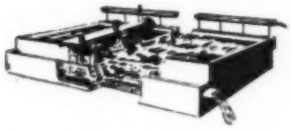


For removal or reclaiming of fine suspended solids from supply water, waste water and sewage. "Auto-Raise" mechanism prevents scraper breakage. Bulletin 31-D-37.

CIRCULAR CLARIFIERS

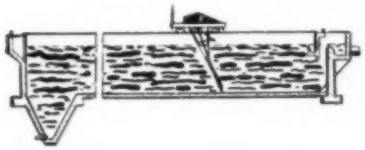
Light and heavy-duty clarifiers for water or sewage, either beam or center-column type, central sludge discharge. Bulletin 35-C-37.

AUTOMATIC BACKWASH SAND FILTERS



For high removal of non-settling or slow-settling suspended matter. Self-cleaning sand bed. No shut-down necessary for back-washing. Traveling backwash carriage. Bulletin 46-37.

RECTANGULAR CLARIFIERS



Especially suited for limited spaces or where sludge delivery is desired at one end of the tank. Particularly suited to sewage treatment, industrial wastes, and oil-water separation in refinery waste water treating. Bulletin 31-D-37.

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CATALOG DIGESTS

122 ROCK BORING DRILLS

The Salem Tool Company—A brochure on the McCarthy auger drills for boring earth, shale, and rock formations, describes vertical and horizontal models as well as mineral recovery drills, tunneling machines, and drills for boring under streets and highways. Booklet contains illustrations of drills in use as well as detailed engineering and operating information. The company manufactures augers from 6 in. in diameter to 60 in. in diameter any length.

123 RUBBER ROADS

Natural Rubber Bureau—A 52-page booklet entitled, "Stretching Highway Dollars With Rubber Roads," is offered. This booklet gives the whole story on the history of rubber roads, and describes in detail the test roads using natural rubber powder that have been laid in the United States and Canada through the 1951 paving season.

124 RUNABOUT DITCHER

Barber-Greene Company—An 8-page, two color booklet, describes the Model 705B "Runabout" ditcher, a wheel mounted unit designed for use by utility companies, governmental bodies and contractors. The machine cuts trenches 5½ in., 7½ in. and 10½ in. wide and to a maximum depth of 4 ft. It is pneumatic tire mounted and is equipped with a fully hydraulic digging transmission, a fluid coupling and many other design refinements.

125 SANITARY LANDFILL

Allis-Chalmers Manufacturing Company—Sanitary Landfill is the subject of a 12-page color catalog discussing in detail this method of garbage and rubbish disposal. Pictures show how sanitary landfills are made and equipment to use.

126 SCOTCH TYPE BOILERS AND STOKERS

James Leffel & Company—The 28-page Bulletin No. 236 covers the complete line of Leffel Scotch Type Boilers which are either oil, gas or coal fired. It also includes underfeed stokers in a wide range of sizes. Photographs and cutaway drawings show boiler design and application details. Test results, case studies and specification data are included. A complete description is also given on the Leffel automatic underfeed stoker, which is suitable for other makes of scotch type boilers.

127 SCREW CONVEYORS AND FEEDERS

Link-Belt Company—offers Book No. 2289 on screw conveyors and screw feeders for handling a wide assortment of materials—light, heavy, fine, coarse, granular, flaky, sluggish, and free-flowing. The book describes and illustrates these units, and contains detailed engineering information, selection tables, horsepower formulas, layouts and arrangements to permit selection of screw conveyors and screw feeders for many types of application.

128 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems, either by cutting off such flows entirely during storm periods, or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

When filling out the coupon, please print your name, address, and business affiliation clearly. Request only the items of particular interest to you. Be sure to enclose checks when requesting charge items.

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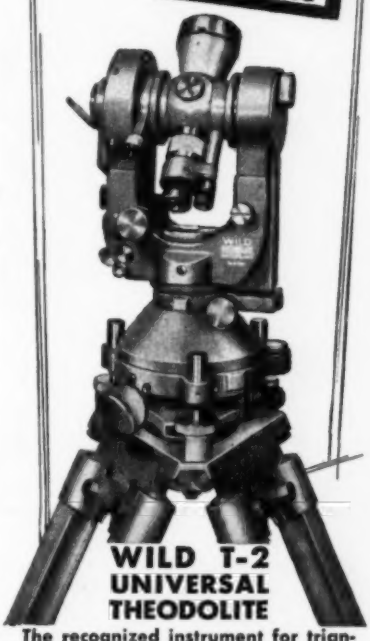

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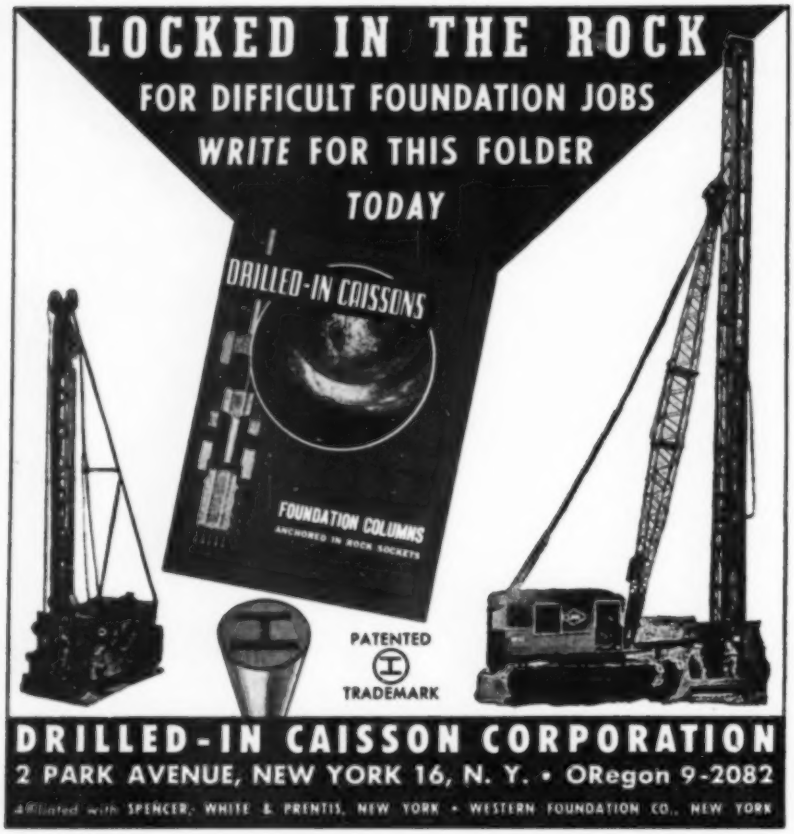
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"GUNITE" CONTRACTORS
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CATALOG DIGESTS

129 SHOT CORE DRILLS

Acker Drill Company, Inc.—offers a bulletin describing the Model KR shot core drill. The KR drill is especially suited for obtaining highway and airport runway test cores from concrete, bituminous or masonry surfaces. The entire unit is light enough for mounting on a pick-up truck or trailer. Power unit can be gasoline, kerosene, diesel or electric motor.

130 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 003. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment air inlet and air release valves.

131 SOIL SAMPLING TOOLS

Acker Drill Company, Inc.—offers a 16-page bulletin describing their complete line of soil sampling tools. The science of soil mechanics and the special tools required for accurate sub-surface exploration in various soil conditions, is thoroughly discussed

132 SPEED-LAY PIPE SYSTEM

Albert Pipe Supply Co., Inc.—An 8-page brochure describes a new rapid laying, economical prepackaged pipe system, complete with pipe, valves, and fittings for temporary or semi-permanent water, gas and air lines. Approved by Civil Defense for prompt city water supply replacement.

133 STEEL FORMS

Economy Forms Corp.—A booklet on steel forms for concrete construction is offered. It has numerous pictures showing the simple handling, applications, and use of the forms for all types of heavy construction; tunnels, culverts, sewage & water treatment plants. Special forms designed to solve concrete construction problems are also shown.

134 STRUCTURAL SHAPES

United States Steel Co.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate-size limitations and basic structural data on bearing piles, steel sheetpiling, floor plate, crane rails, and corrugated sheets.

135 SURVEYING & DRAFTING INSTRUMENTS

Henry Wild Surveying Instruments Supply Co. of America, Inc.—offers an illustrated booklet containing condensed data on time saving Wild surveying and drafting instruments. After March 1, 1953, the company's executive offices, sales and repair facilities will move to expanded quarters in Port Washington, N.Y. This change in locations will afford better service in sales and enlarged repair facilities.

136 SURVEYING INSTRUMENTS

C. L. Berger & Sons, Inc.—A 16-page condensed catalog, "Accuracy in Action", illustrates the engineering and surveying instruments manufactured by the company. General characteristics, optical systems and accessories for the Berger line of engineers' transits, levels, mining transits, theodolites, collimators and alidades are fully described with essential specifications for each. A section devoted to builders' and contractors' instruments is also included.

When ordering literature for which there is a charge, please make checks payable to the company offering the material!

★ *For the Engineer's Reference Shelf—* ★

Statically Indeterminate Structures

PAUL ANDERSEN, *University of Minnesota.* This new book directly associates structural analysis with structural design. Throughout, numerical applications of actual design problems are an integral part of the work which includes an entire chapter on typical design problems. Emphasizes deflections, their importance in understanding the behavior of structure under load. 370 ills., tables, 318 pp. $7.50

Substructure Analysis and Design

Also by PAUL ANDERSEN. A comprehensive discussion of the analysis and design of those portions of structures below the surface of the ground, water, or both. Written from the designing engineer's viewpoint, it develops theories from design problems and presents methods for working out safe, economical design plans. Covers foundations, bulkheads, cofferdams, wharves, abutments, etc. 244 ills., tables, 305 pp. $5

Basic Reinforced Concrete Design

GEORGE ELWYN LARGE, *Ohio State University.* A problems method approach giving step-by-step information on fundamentals of beam bending, beam shear, columns, and practical continuity. Complete analysis of all topics plus practical illustrations show evolution of design formula in detail. Special attention to shear, diagonal tension, anchorage. 154 ills., tables, charts, 340 pp. $5.50

Structural Design in Metals

CLIFFORD D. WILLIAMS, *Patchen & Zimmerman; and* ERNEST C. HARRIS, *Fenn College.* Providing full coverage of structural design, this volume emphasizes the application of statics and strength of materials to details of design for all types of structures. Recognizes advanced design methods in aircraft and the increased use of metals other than steel. Stresses use of light-guage members, rigid frame design. 349 ills., tables, 596 pp. $7

Highway Engineering

L. J. RITTER, JR., *University of Florida; and* R. J. PAQUETTE, *Georgia Institute of Technology.* Topics are arranged in the actual sequence of factors met in the construction of roads and highways. Full information on rural highway construction and improvement; specific data applicable to the construction of city streets and airports. Concludes with a detailed section on the important problems of maintenance. 260 ills., tables, 721 pp. $7.50

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CATALOG DIGESTS

137 SURVEYING INSTRUMENTS

Paul Reinhart Co., Inc., Kern Surveying Instrument Division—A 32-page brochure offers a brief description of the most important instruments manufactured by world-famed Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are double-circle theodolites, self-reducing tachometers, plane table equipment, pentagonal prisms and many other exceptionally fine instruments.

138 SURVEYING INSTRUMENTS

Warren Knight Co.—The 56 page, 10th Edition of the company's catalog of precision transits, levels, clinometers, protractors, etc., and a general line of engineering equipment and supplies is now available for distribution to engineers without charge or obligation.

139 SURVEYING INSTRUMENTS

David White Company—offers Bulletin 1052 on surveying instruments for all purposes. The present edition tells the story of the most recent changes and developments in the field of surveying instruments and engineer's field supplies. The catalog presents an exceptionally large assortment of high-grade and up-to-the-minute products.

140 SWITCH MATERIALS

L. B. Foster Company—The 44-page "Switch Material Catalog" provides a single-source reference for the selection of an integrated line of switch materials. Equipment covered includes frogs, switches, turnouts, tie plates, side plates and braces, switch rods and bars, crossings, switch stands, switch throws and stands and other related parts. All equipment is fully illustrated and their applications explained.

141 TANDEM ROLLERS

Galion Iron Works & Mfg. Co.—Catalog No. 325 on variable weight tandem rollers is offered. The many improvements in construction and operation are fully described and illustrated. Complete specifications are also listed.

142 TECHNICAL BOOKS

John Wiley & Sons, Inc.—Information on authoritative, up-to-date technical books in all branches of civil engineering is available in a special Wiley catalog. Of particular interest to civil engineers are the descriptions of standard reference and textbooks on structural engineering, foundations, hydraulic and hydroelectric engineering, municipal engineering, architecture, irrigation, highway and bridge engineering, building construction, and many other related subjects.

143 TECHNICAL DATA CATALOG

Lefax—Listing over 2000 subjects, the Lefax catalog of pocket size technical dollar data books is off the press. These handy reference books cover every branch of engineering, are clear cut, comprehensive, authoritative, for use by engineers, technical workers, executives, etc. Continuously revised, each book contains approximately 140 pages of pertinent data including current advances. Subjects include: hydraulics, machine design, piping data, surveying tables, reinforced concrete, highway engineering, electricity AC-DC, AC motors and generators, and others.

144 THEODOLITE

Geo-Optic Company, Inc.—has a leaflet describing the optical universal theodolite T50 with terrestric telescope (erecting eyepiece). The T50 enables surveyors to cope with any possible problem of triangulation and to obtain results of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

145 THREE-WHEEL ROLLERS

The Galion Iron Works & Mfg. Co.—An attractive four-color catalog No. 294, describes the company's three wheel rollers. Complete specifications are given together with detailed description and photos of the many construction and operation features.

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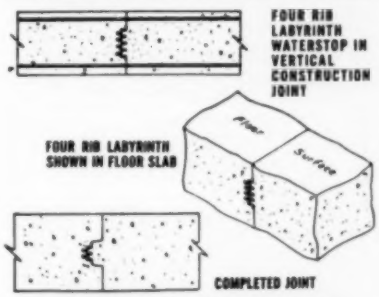

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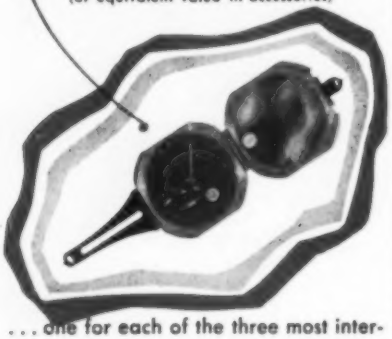

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TIDE GATES

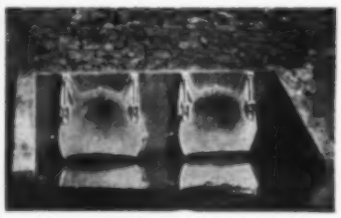

Fig. B-124-D
Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

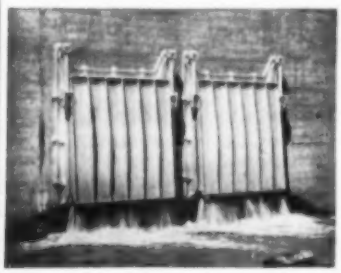

Fig. B-124-C
Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
LIMA, OHIO, U.S.A.

CATALOG DIGESTS

146 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

147 TILT-UP CONSTRUCTION

Portland Cement Association—A 32-page illustrated booklet discusses a method of construction in which wall panels are cast in the horizontal position, usually on the floor of the building and then tilted into a vertical position and tied together to form a wall. It covers the advantages, design, construction details, methods of tilting and insulation of walls.

148 TOOL SHEDS, OFFICES

Dravo Corporation—A 12-page bulletin No. 226, "Facts", describes the Dravo Transportainer, a 275 cu ft steel container used for shipping fragile and valuable cargo in ocean commerce and as portable tool sheds, field offices and for dynamite storage in construction and road-building work.

149 TRACING PENCIL TEST KIT

American Lead Pencil Co.—The kit contains samples of Venus tracing pencils for testing on various types of tracing papers. This new pencil contains an active chemical to produce clearer, sharper white or blueprints when reproduction is made from a pencil drawing.

150 TRACK ACCESSORIES

L. B. Foster Company—Newly published, fully illustrated with photographs and drawings, the 32-page "Track Accessory Catalog" covers the entire field of track accessory equipment. Over seventy different pieces of equipment such as derails, car stops and car movers, door openers and closers, jacks, liners, track tools, etc., are clearly illustrated and their applications described.

151 TUNNEL & MINE EQUIPMENT

Mayo Tunnel & Mine Equipment—Bulletin No. 18 shows compressed air locomotives and car passers. These air locomotives are low in first cost and are very useful for small and short jobs.

152 TUNNELING

Commercial Shearing & Stamping Co.—Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 300 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Commercial Shearing & Stamping Co.

153 UNDERPASSES

Armco Drainage & Metal Products, Inc.—A 16-page booklet, "Manual of Underpasses, Tunnels and Conduits," describes the safety, convenience and economy of these structures. It covers various types of corrugated metal structures, sizes and shapes, and illustrates typical applications. Useful tables are included, also data on underpasses for pedestrians and livestock, conveyance tunnels service tunnels and conduits. Other sections describe methods of obtaining openings, field construction service, and finishing and equipping.

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CATALOG DIGESTS

154 VENTURI METER

Simplex Valve & Meter Co.—Bulletin No. 401 describes in detail the operation and installation methods of the type H meter register. This is a circular-type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

155 VIBRATING SCREENS

Link-Belt Company—describes and illustrates its "CA" concentric action vibrating screens for medium and heavy duty service, accurate sizing, and thorough rinsing and rapid dewatering of a wide range of materials in Book No. 2354. The "CA" vibrator mechanism imparts a smooth, positive, circular motion to all screening surfaces. Book gives dimensions, weights, and other engineering layout data.

156 VIBRATORY COMPACTING EQUIPMENT

Jackson Vibrators, Inc.—has a bulletin on electric vibratory compacting equipment, available in 12 in. to 12 ft widths to meet requirements. A better, faster means of densification in; macadam construction, bituminous mixes, granular soils, pavement widening & patching.

157 WATER CONDITIONING HANDBOOK

The Permutit Company—Pocket size Data Book No. 2478A was compiled for the convenience of practicing engineers and those who work with water conditioning problems. It covers such subjects as hydraulics, impurities in water, chemicals used in water treatment, specific gravities and chemical reactions. The 102 pages of invaluable data, with 77 tables of information is bound in a leatherette cover and gold stamped.

158 WATER DAMAGE CONTROL

Western Waterproofing Co.—A practical, professional treatise, illustrated with case history photos, covers all phases of preventive, remedial and restorative treatment of both old and new structures.

159 WATER FILTERS

Proportioneers, Inc.—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specifications and dimensions covering the complete recirculation and purification systems, are given.

160 WATER LINE REQUIREMENTS

Price Brothers Co.—has "Check Sheet of Water Line Requirements", a four-page bulletin that can be extremely helpful to consultants and to water works management and engineers. Lists and subdivides major requirements, as life expectancy, strength, gallons of water delivered, maintenance and cost. A comparison check form is provided on which you can evaluate the benefits of each type of pipe line material you may want to consider.

161 WATERPROOFING

Western Waterproofing Co.—has a comprehensive guide showing how to protect both new and old structures from: above-grade water penetration with Resto-Crete system and Dilato expanding mortar; interior wall dampness with Parge coat; sub-surface water seepage with Ironite. Detailed data and sample specifications for these services are included.

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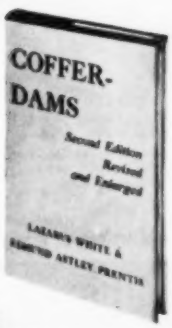

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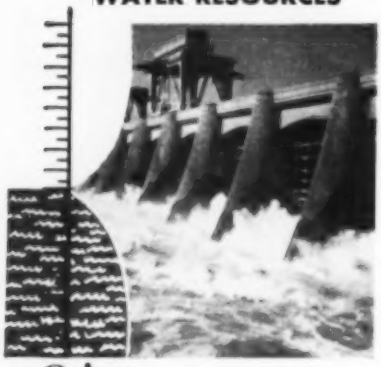

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CATALOG DIGESTS

163 WATER PURIFICATION EQUIPMENT

Infilco Inc.—Bulletin 1825-B describes the principle and applications of the Accelator for treatment of wastes by chemical means in a single, compact unit which combines mixing, coagulation and clarification.

164 WATER-REPELLENT

A. C. Horn Company, Inc.—Dehydratine No. 22, the silicone base water-repellent for untreated exterior masonry surfaces above grade, is described in a bulletin. The six functions it performs at one time are presented and photographs and specifications are included.

165 WATERSTOPS-LABYRINTH TYPE

Water Seals, Inc.—A bulletin describes the Harza labyrinth waterstop. The catalog includes description and drawings of typical applications for the new type waterstop, which features exceptional water tightness and ease of installation in the concrete forms.

166 WELDED STRUCTURES

Lincoln Electric Company—offers a series of case studies of modern welded structures which exemplify the best in welded design fundamentals. The current study is a review of six recently erected welded buildings ranging from office buildings to apartment houses. Other studies recently presented include a 5 span, 480 ft highway bridge; a study of welded joint details and the rigid frame design.

167 WELLPOINT DEWATERING

Complete Machinery and Equipment Company—has a catalog entitled, "Dewatering the 'Complete' Way." The catalog has been published for the sole purpose of showing the ease of installation, operation and maintenance of "Complete" wellpoint systems. Included in the catalog are many pictures of dewatered construction areas where construction "in the dry" has been accomplished as well as diagrammatic sketches of proper location of wellpoint equipment to handle sub-surface water on various types of construction projects.

168 WELLPOINT DEWATERING SYSTEM

John W. Stang Corp.—A catalog describes the component parts of the Stang wellpoint dewatering system; its planning, engineering and various methods of installation. Specific installations on dams, power houses, pipelines, tunnels, etc., are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

169 WELLPOINT SYSTEM

Moretrench Corp.—"Working in the dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on-the-job photos.

170 WELLPOINT SYSTEMS

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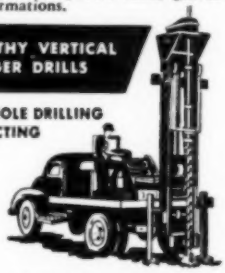

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Summarized in Earlier Issues

166. **The Design of Flexible Bulkheads,** by James R. Ayers and R. C. Stokes.

167. **Sewage Disposal in Tidal Estuaries,** by Alexander N. Diachishin, Seth G. Hess, and William T. Ingram.

168. **Special Design Features of the Yorktown Bridge,** by Maurice N. Quade.

D-117. Discussion of Paper, **The Development of Stresses in Shasta Dam,** by J. M. Raphael.

D-122. Discussion of Paper, **Engineering Aspects of Diffraction and Refraction,** by J. W. Johnson.

D-125. Discussion of Paper, **Torsion of Plate Girders,** by F. K. Chang and Bruce G. Johnston.

Third Notice

169. **Rating Curves for Flow over Drum Gates,** by Joseph N. Bradley.

170. **Rapid Computation of Flexural Constants,** by Thomas G. Morrison.

171. **Unified Mass-Transportation System for New York,** by William Reid.

172. **Aeronautical Charting and Mapping,** by Charles A. Schanck.

173. **Electronic Devices in Air Transport,** by F. B. Lee.

174. **Zoning Maps for Airports,** by Benjamin Everett Beavin, Sr.

175. **Design of Side Walls in Chutes and Spillways,** by D. B. Gumensky.

D-121. Discussion of Paper, **Rate of Change of Grade per Station,** by Clarence J. Brownell.

D-127. Discussion of Paper, **Stresses in Deep Beams,** by Li Chow, Harry D. Conway, and George Winter.

Second Notice

176. **Advances in Sewage Treatment and Present Status of the Art: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment.** Information on developments throughout the field of sewerage and sewage treatment during the period from January 1, 1950, to October 1, 1951, is presented for consideration by the profession. The control of water pollution, new projects and methods of treatment plant operation, chemical treatment, the disposal of sewage and sludge, and litigation are among the many subjects treated. A bibliography of literature pertinent to the period of the report is appended. (Available April 1.)

177. **Earthquake Stresses in Shear Buildings,** by M. G. Salvadori. A practical step-by-step procedure for determining the elastic stresses in a multistory building if it is subjected to earthquake displacements is presented. Incidental factors such as the rocking of a building on an elastic soil and the influence of internal damping are adroitly provided for. (Available April 1.)

178. **Rainfall Studies Using Rain-Gage Networks and Radar,** by H. E. Hudson, Jr., G. E. Stout, and F. A. Huff. The results of research in the measurement of rainfall by means of dense rain-gage networks and by means of radar are presented for consideration in this paper. The multicellular characteristic of thunder-storm rainfall is studied, and area-depth data are presented. It is indicated that radar is of superior or equal value in studying rainfall, as compared with rain-gage networks. The equipment and procedure for such radar studies are described, and data resulting from this work are presented. (Available April 1.)

179. **Stiffness Charts for Gusseted Members Under Axial Load,** by John E. Goldberg. This paper presents charts that yield values of flexural coefficients to be used in a slope-deflection and moment-distribution analyses of secondary stresses in truss members or in the stability analysis of trusses. The actual gussets are assumed to have been replaced by shorter gussets of infinite rigidity. Workers in the specialized field of stability and secondary stresses in truss members should find the mathematical development and the charts useful and worthy of study. (Available April 1.)

180. **A Direct Step Method for Computing Water-Surface Profiles,** by Arthur A. Ezra. A semi-graphical method for the computation of backwater curves, based on Bernoulli's theorem, has been developed in this paper. The effects of eddy losses, bridge-pier losses, and overbank flow can be included. This method should prove interesting to hydraulic engineers because of its convenient general applicability and special usefulness in computing many water-surface profiles for a single channel. (Available April 1.)

D-123. Discussion of Paper, **Long-Period Waves or Surges in Harbors,** by John H. Carr. This paper reports on field and model studies of sources and characteristics of long-period waves in harbors, the subjects of basin resonance, water motion induced by the waves, and the adaptability of models to this type of study. Discussers are: John S. McNown, B. W. Wilson, and John H. Carr. (Available April 1.)

INSTRUCTIONS

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D-126. Discussion of Paper, **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock. The standard of reference of this paper is flow of air in level, open country, with recommendations based on velocity pressures rather than on design pressures. Discussers are: W. Watters Pagon, Irving A. Singer and Maynard E. Smith, Percy H. Thomas and M. H. Fresen, Robert A. McCormick, Edward Cohen, and R. H. Sherlock. (Available April 1.)

D-128. Discussion of Paper, **Horizontally Curved Box Beams,** by Charles E. Cutts. The original paper, published in May 1952, derived equations for the stresses and deformations of a beam curved horizontally through an angle of 90° and resting on four supports. This beam was considered to be of hollow cross section. The testing of curved box beams was described and the results of the experiments were presented. Discussers are: A. George Mallis, DeForest A. Matteson, Jr., and Charles E. Cutts. (Available April 1.)

First Notice

181. **Slackwater Improvement of the Columbia River,** by O. E. Walsh. Navigation on the Columbia River and its tributaries has for many years been of considerable importance to the economy of the basin. A description and history of this region are presented, and the slackwater improvements that have been made or authorized are brought to the attention of the profession. The effects of the improvements are analyzed, and conclusions as to their value are presented for discussion. (Available May 1.)

182. **Hipped Plate Analysis, Considering Joint Displacement,** by Ibrahim Gaafar. The study of hipped plates has omitted proper considerations of the effect that the relative displacements of the joints may have when determining stresses by the commonly accepted methods. The author shows how such an analysis can be corrected to give stress values that more closely conform to experimental results; and he indicates the magnitude of error possible if such a correction is ignored. The assumptions behind the author's theoretical development, and the experimental results that he presents should prove of great interest to the profession. (Available May 1.)

183. **Group Loadings Applied to the Analysis of Frames,** by I. F. Morrison. In an effort to decrease the time-consuming labor involved in analyzing highly indeterminate structures, the author presents the theory upon which rests the method of group loading. Group loadings are used for reducing a set of simultaneous equations to a set of one-term equations which are easily solved. The author indicates, in several examples, how the theory may be applied most effectively. This involves judicious choice of the primary structure at the start of computations. (Available May 1.)

184. **Dam Modifications Checked by Hydraulic Models,** by E. S. Harrison and Carl E. Kindsvater. A review of hydrologic and structural conditions pertaining to Bartlett's Ferry Dam, after the dam had been in service for twenty-five years, showed that major structural modifications were advisable. Chief among these was the addition of prestressed, reinforced concrete buttresses to the concrete spillway. Questions regarding the hydraulic characteristics of the modified spillway prompted the model studies described in this paper. Results of uplift measurements on the dam, a description of the structural modifications to the dam, and a description of the model tests are presented for discussion. (Available May 1.)

185. **Nonelastic Behavior of Bridges Under Impulsive Loads,** by S. J. Fraenkel and L. E. Grinter. For the case of simple-span bridges with deformations extending into the plastic range, the authors present a procedure for predicting the effects of bridge loads such as might be produced by an atomic explosion. Loads which vary with time and many other variables may be introduced into the problem. The particular loading studied is produced by a nominal atomic bomb vertically above midspan. Important considerations in determining the damage sustained are the span, the mass of the bridge, the deck elevation, and the type of structure. (Available May 1.)

186. **Settling Rates of Suspensions in Solids Contact Units,** by A. A. Kalinske. Accurate knowledge of the settling characteristics of various suspensions is of special importance in the upflow type of clarification equipment. The settling rates of various slurries, suspension, and sludges determine the permissable upflow rates in such units, and also the methods and equipment used in concentrating the sludge to be discharged from the units. For consideration and discussion by the profession, the author presents general information on the settling characteristics of various suspensions and demonstrates the application of these data to the design and operation of waste and waste treatment and clarification basins. (Available May 1.)

187. **The Equivalent Rectangle in Prestressed Concrete Design,** by John J. Peebles. In order to facilitate the design of prestressed concrete beams, the author presents a method whereby cross-sectional shapes and dimensions for such beams may be selected in a manner similar to that used for selecting structural steel shapes. The procedure is reasonably simple, and is based on the concept of a rectangular cross-section that has the same section modulus as that of the beam to be designed. This paper should help to stimulate new thought in a rapidly developing field. (Available May 1.)

188. **Laminar to Turbulent Flow in a Wide Open Channel,** by W. M. Owen. This paper presents theoretical equations for the velocity and rate of flow for laminar flow of fluids in rectangular channels and in channels of infinite width. Experimental data are studied relative to the determination of the critical value of the Reynolds number at which the flow changes from laminar flow to turbulent flow. Comparisons of experimental results with those obtained by theory are presented for discussion, and the transition range between true laminar flow and turbulent flow is examined. (Available May 1.)

D-135. Discussion of Paper, **Application of Electronic Flow Routing Analog,** by Max A. Kohler. The electronic stream-flow analog of the Weather Bureau was studied in the original paper, published in June, 1952. This analog was found effective for river forecasts where the Muskingum storage equation is applicable. The basis for the circuit used in the analog and the methods of operating the equipment were discussed briefly in the paper, together with an explanation of a basis for making analog routing more universally applicable. Discussers are: Alfred J. Cooper, and C. O. Clark. (Available May 1.)

D-136. Discussion of Paper, **Steady-State Forced Vibration of Continuous Frames,** by C. T. G. Looney. The original paper, published in June, 1952, described a method of analysis for the steady-state forced vibration of continuous frames. All members are considered as simply supported, and the geometrical discontinuity with adjacent members is corrected by means of a distribution procedure. Discussers are: E. F. Masur, A. S. Veletsos, and William A. Conwell. (Available May 1.)

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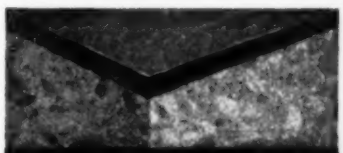

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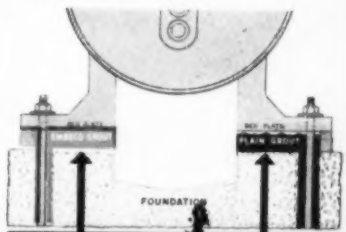

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